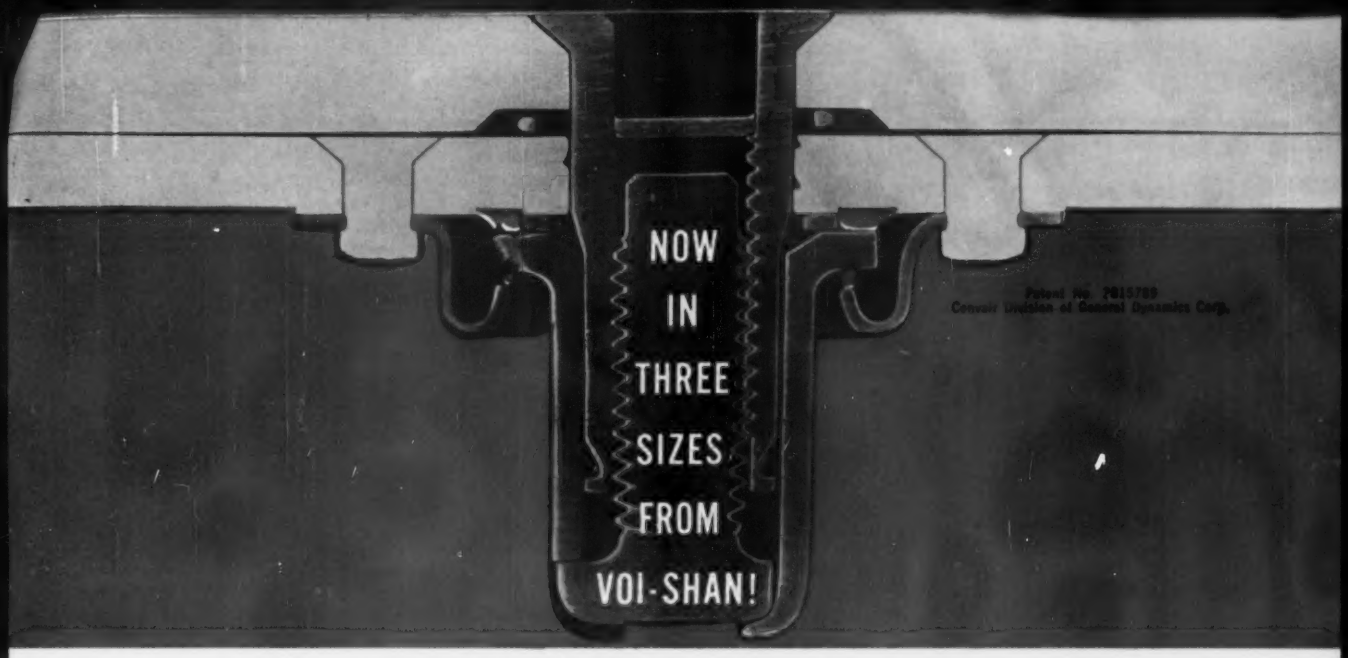
July 4, 1960

Aviation Week and Space Technology

Perceptron Tests Concept's Feasibility

SAC Crewmen Mate GE Nose Cone to Atlas



MILSON STRUCTURAL PANEL FASTENERS

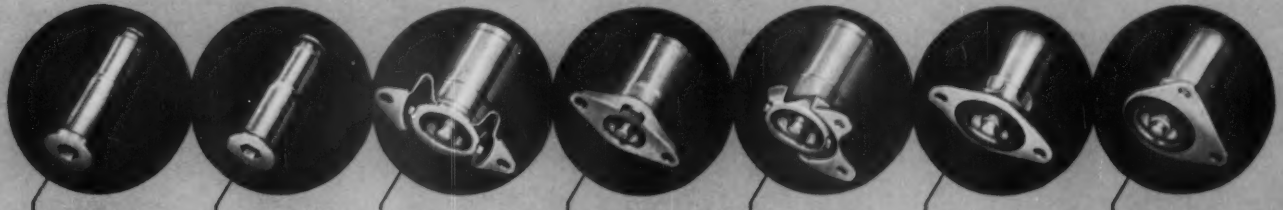
Now Voi-Shan's three sizes bring all the advantages of Milson Fasteners to almost any application that calls for quickly removable structural panels. Milson Fasteners make the panel an integral part of the primary structure—yet permit fast, repeated access to equipment behind the panel. Voi-Shan's three structural sizes, ¼", 5/16", ⅜", two sleeve bolt head styles, five receptacle configurations, and two temperature ranges permit maximum design flexibility.

Milson Fasteners close gaps up to .125 in. with four or less turns—permit hole misalignments up to .040 in. Self-locking, they have only four parts, need no adjustment, and can be re-used 350 or more times. Deep hex socket provides quick tool insertion, high preload, superior power driving, and longest recess life. Milson Fasteners have common hole size in the panel and substructure and all parts are completely interchangeable, available in alloy steel for temperatures to 550°F; in corrosion-resistant steel to 700°F; and with self-sealing receptacles.

For new brochures, further information, prices, and/or technical assistance on this and other quality fastener products, you are invited to contact Voi-Shan's Sales Service Department.

COMPARISON CHART:

SIZE	DIAMETER	SINGLE SHEAR	ULTIMATE TENSILE	RIVET SPACING
Milson 1900-4	.250	2,250	2,000	.688—.750
NAS 547 #0	.312	2,720	1,290	.750
Milson 1900-5	.312	4,750	3,500	.875
NAS 547 #1	.375	4,650	2,210	.875
Milson 1900-6	.375	6,500	6,000	.875—1.000



Milson 1910 Protruding Head Sleeve Bolt*

Milson 1920 Flush Head Sleeve Bolt*

Milson 1950 Standard Two-Leg Receptacle Assembly*

Milson 1955 Reduced Rivet Spacing Receptacle Assembly*

Milson 1960 Standard Corner Receptacle Assembly*

Milson 1970 Two-Leg Self-Sealing Receptacle Assembly**

Milson 1980 Corner Self-Sealing Receptacle Assembly**

*In alloy steel for temperatures to 550°F; or corrosion-resistant steel to 700°F.

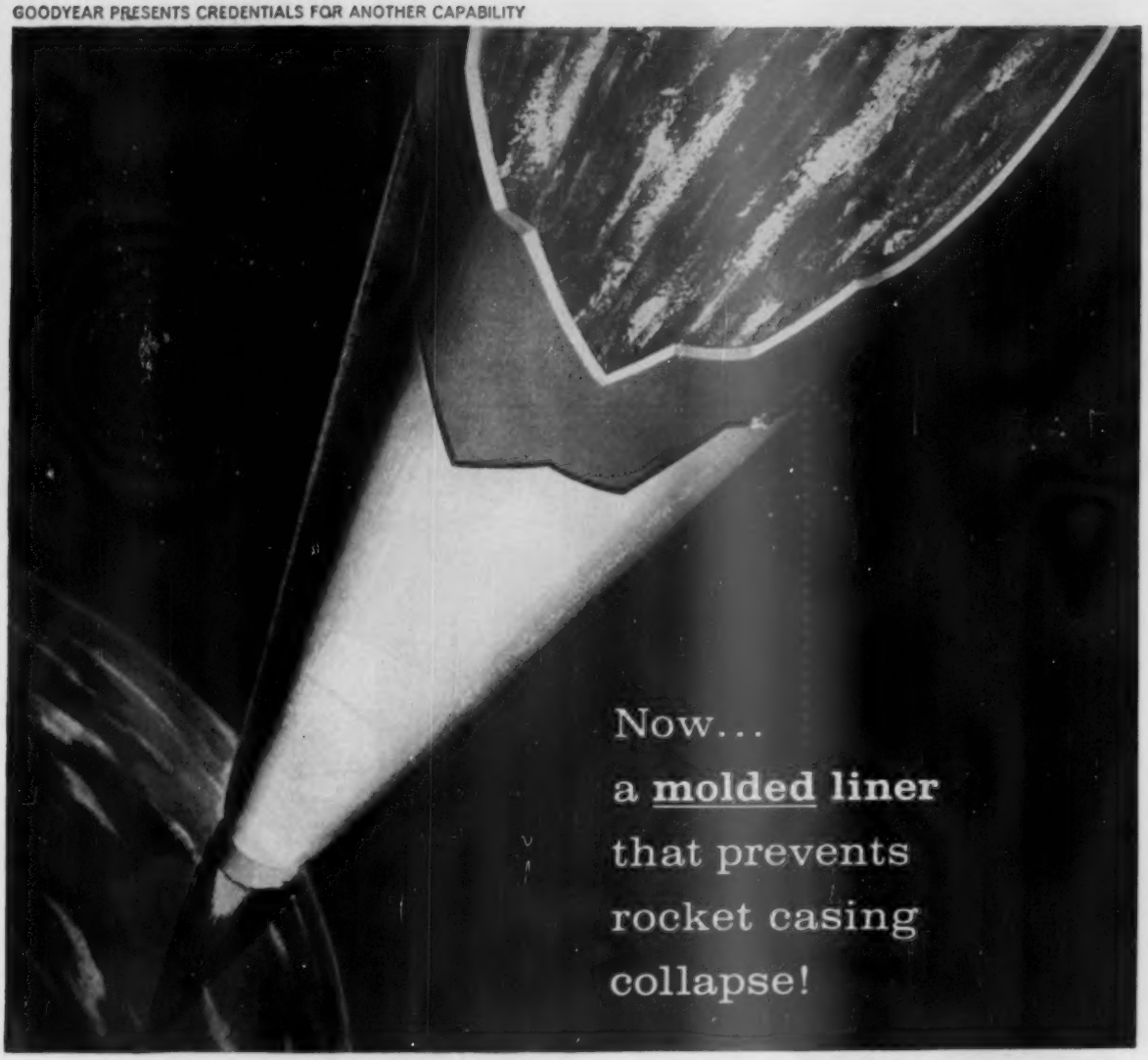
**In alloy steel; seal material meets applicable requirements for use with aircraft types 1, 2 & 3 fuels per Spec. MIL-R-6855. Applicable temperature range —65°F to +260°F. Applicable pressure range ±50 P.S.I.

VOI-SHAN MANUFACTURING COMPANY

VSI

A Division of Voi-Shan Industries, Inc.
8463 Higuera Street, Culver City, California

GOODYEAR PRESENTS CREDENTIALS FOR ANOTHER CAPABILITY



1. Keeping rocket casings from buckling under extreme thrust temperatures produced by our second-generation missiles was a serious problem. One solution: Increase casing thickness. But this imposes severe weight penalties. What was needed: A lightweight insulating material able to withstand heat up to 7,000°F. for as long as two minutes.

2. To meet this need, Goodyear has perfected a technique of *high-pressure molding* rocket liners from a new Navy-developed rubberlike compound. Goodyear's molding process on such rubberlike materials achieves unprecedented dimensional accuracy as well as the ability to duplicate this precise accuracy in succeeding production units. Result: A liner that is not only precisely true to specified tolerances but also free of voids and contamination. In use, the liner erodes away and is discharged in the tail blast, leaving no dead weight within the rocket.

3. Now being checked out for advanced missiles, this Goodyear liner makes possible thinner casings – bigger pay loads. Because it's molded, moreover, it can be formed to almost any configuration and degree of taper. Molding techniques for materials, as well as the development of new materials for use in difficult insulation areas such as in tail cones and nose cones for re-entry vehicles, etc., are now being evaluated at Goodyear.

For complete details, write on company letterhead or phone: The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. S-1715, Akron 16, Ohio, or Los Angeles 54, California.

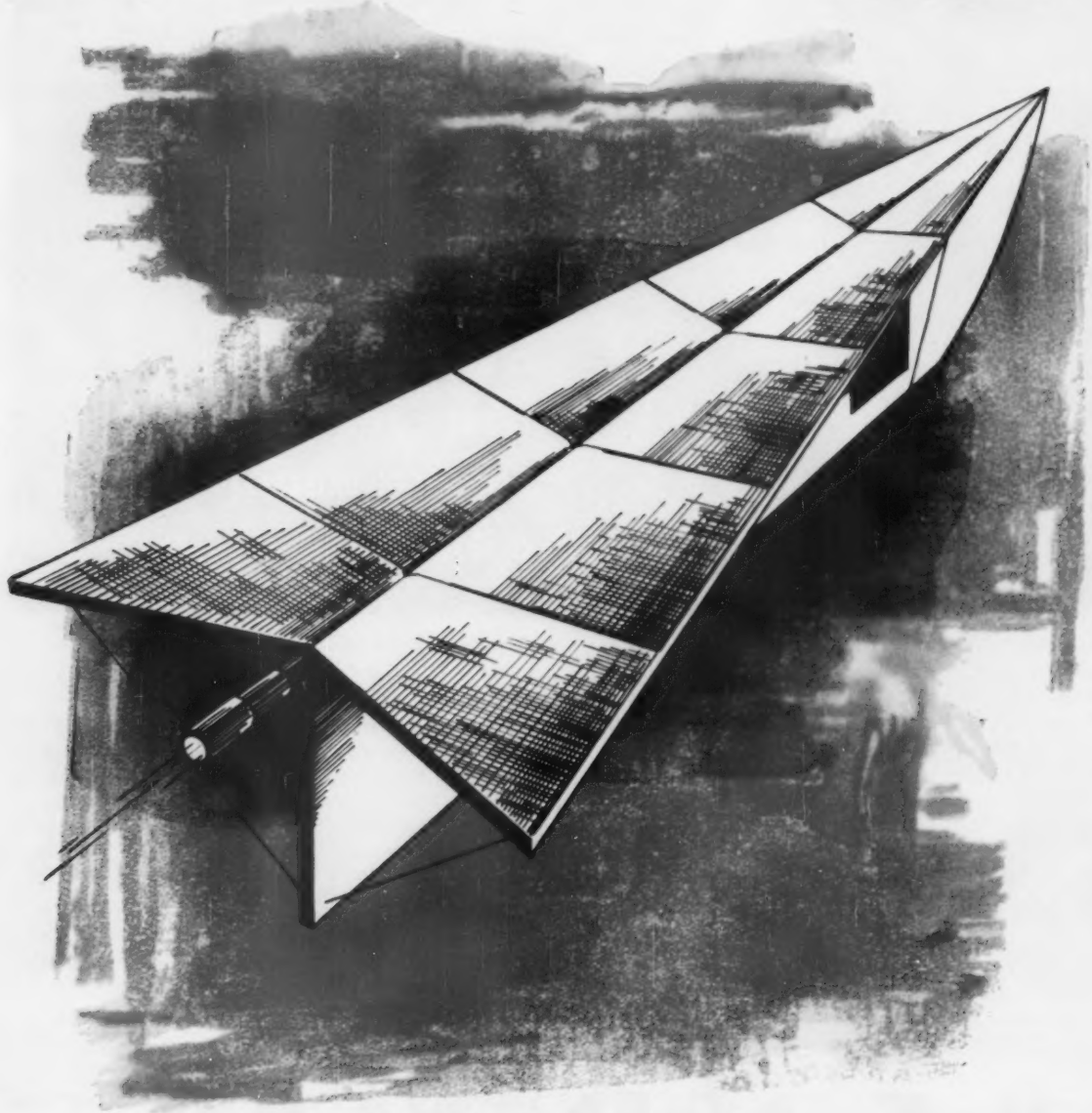
Lots of good things come from **GOODYEAR** AVIATION PRODUCTS

More aircraft land on Goodyear Tires, Wheels and Brakes than on any other kind

a message to men who keep a thought ahead of progress . . . Butler and Edwards lacked all but vision when they designed their 19th century delta-winged jet. ■ But with today's methods and materials, vision itself is often the only requisite to progress. ■ If your concepts border on reality, perhaps Ex-Cell-O's experience can help turn your prints into skyborne products through our precision-machined parts and assemblies, fuel control devices, servomechanisms, actuators, inertial guidance systems, remarkably precise, numerically-controlled machine tools, and other manufacturing capabilities available to you today. ■ Call our Representative, or contact Ex-Cell-O's Aircraft & Missile Division, Detroit.

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN 60-10
Aircraft & Missile Division

The use of a solid fuel propellant, and a sliding nacelle amidships for longitudinal control, were among the advanced features of this jet aircraft design proposed by Englishmen Butler and Edwards in 1867.



SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO., SMITH BEARING CO. ■ EX-CELL-O FOR PRECISION XLO

AVIATION CALENDAR

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 18-19—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Beverly Wilshire Hotel, Beverly Hills, Calif.

July 21-27—Third International Medical Electronics Conference & Exhibition (including session on medical electronics in space research), London, England.

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 16-18—Fourth Annual Tri-Service Conference on Biological Effects of Microwave Radiation, New York University Post-Graduate Medical School, NYU Medical Center, N.Y.C. Sponsor: Air Research and Development Command.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

(*Continued on page 6*)

AVIATION WEEK and Space Technology

July 4, 1960
Vol. 73, No. 1

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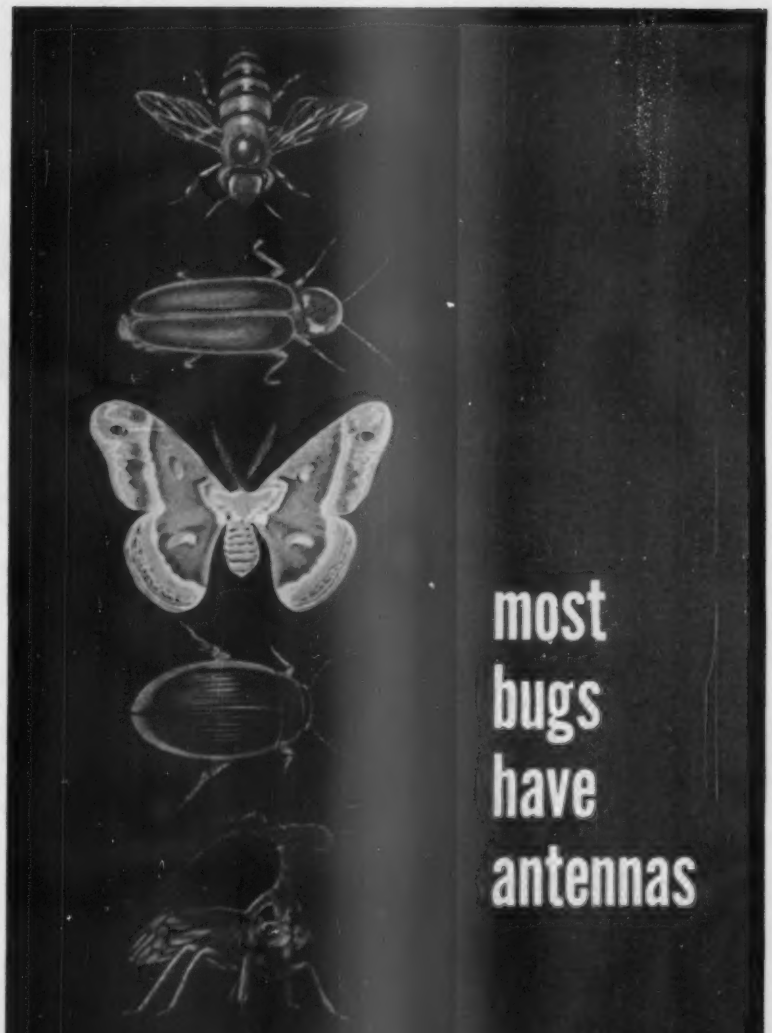

...but the reverse of the above statement is being challenged successfully at Dorne & Margolin, Inc.

It has taken insects thousands of years to evolve countless variations of antennas to suit environmental conditions and adapt them to perform specific functions perfectly. Dorne & Margolin engineers have less time at their disposal, yet they achieve similarly satisfactory end results.

And the insect world has nothing on Dorne & Margolin when it comes to all-out organization to get the job done. Meticulous as bees, determined as ants, more curious than moths . . . that's the approach to every problem in components or systems . . . aircraft or missiles, practiced by D & M engineers.

The results have been products in which we can confidently take pride . . . just ask our customers*. By the way, our engineers still have a healthy and creative curiousity about antenna problems. If there's one plaguing you, no matter how large . . . or small, drop us a line.

*A customer list is included in our Antenna Catalog. Write for your copy today.

DORNE & MARGOLIN, Inc.

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a perfect blend of skill,
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The ***SPACE-TRONICS*** "reality"
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physicists, mathematicians and
engineers who have made singular
contributions to almost all of our
major weapon systems programs
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gathered together an exceptional
team of men with complementary
talents and has provided them with
the finest possible facilities for
advanced research and development.
The result: A concrete
concept for accomplishment.

a concrete concept for accomplishment

Space Communications
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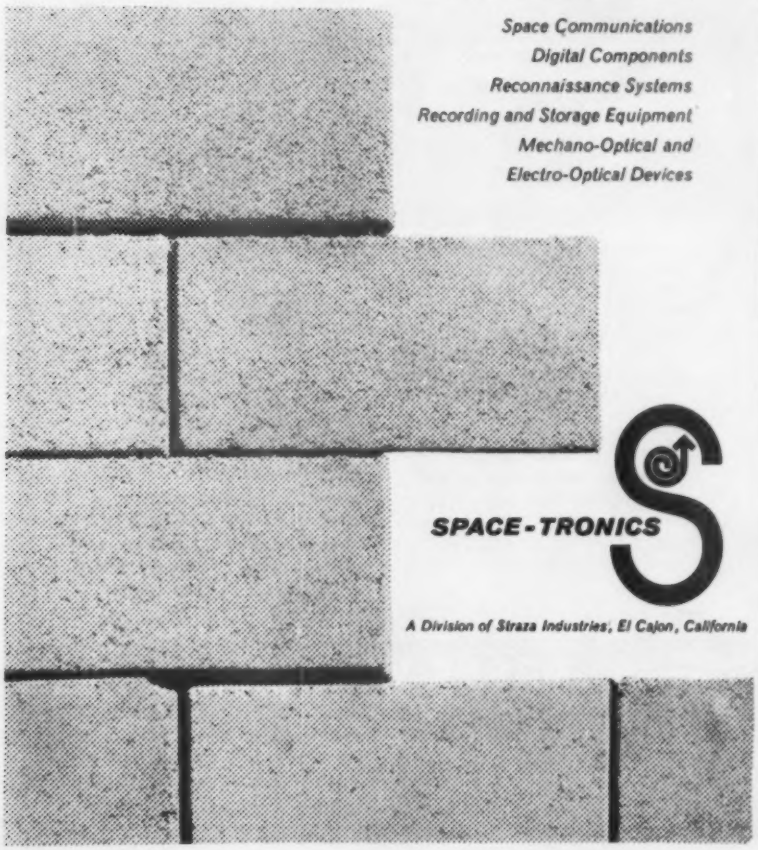


SPACE-TRONICS

A Division of Straza Industries, El Cajon, California

AVIATION CALENDAR

(Continued from page 5)

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado, Boulder, Colo.

Aug. 23-26—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America; American Society of Mechanical Engineers; American Institute of Electrical Engineers; Institute of Radio Engineers; American Institute of Chemical Engineers.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica. Cosponsors: USAF; U. S. Army; U. S. Navy; NASA; AEC.

Oct. 3-5—Sixth National Communications Symposium, Institute of Radio Engineers, Utica, N. Y.

Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, including USAF Office of Scientific Research Astronautics Conference, Ambassador Hotel, Los Angeles, Calif.

NEW NEW FROM PUROLATOR:

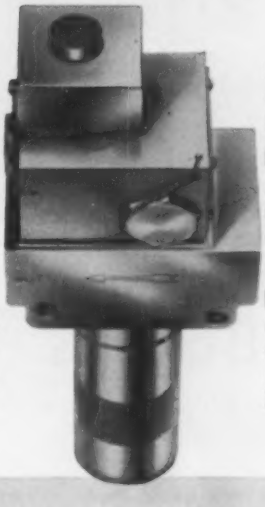
NEW NEW

A FILTER THAT TELLS YOU WHEN IT NEEDS CLEANING

The indicator in the top of this new Purolator filter pops up automatically the moment the element is too clogged to filter accurately. When the element has been cleaned, you simply depress the button until it resets automatically. It stays down, hidden, until the next cleaning is due. That's all there is to it.

WHERE CAN YOU USE IT?

In any fluid system (up to 275°F, 5000 psi) where differential pressure can be used for measurement. The mechanical indicator filter can be made for practically all sizes and operating conditions. It can be designed with or without relief valves and by-pass arrangements.



High filtrate viscosity caused by low temperature won't trigger the indicator because the piston is locked in place below 30°F.

HOW FINE DOES IT FILTER?

Anywhere from 5 to 50 microns, depending on the filtering medium used. Units now in production meet indicator requirements for proposed MIL SPEC: MIL-F-8815.

HOW BIG IS IT—HOW MUCH DOES IT WEIGH?

Check through the chart of standard specifications below. If you want more information, fill in the coupon and mail it to Purolator Products, Inc., Department AW50, Rahway, New Jersey.

STANDARD SPECIFICATIONS

	G-416-1 ASSEMBLY NO. 60878	ASSEMBLY NO. 6652965	ASSEMBLY NO. 6652922
MATERIAL	(Capacity — 5 GPM)	(Capacity — 12 GPM)	(Capacity — 23 GPM)
Head	Aluminum	Aluminum	Aluminum
Case	Aluminum	Aluminum	Aluminum
Element	Stainless Steel Wire Cloth	Stainless Steel Wire Cloth	Stainless Steel Wire Cloth
DIMENSIONS			
Overall	$8\frac{5}{64}$" long x 3" (btw. conn.)	$9\frac{7}{16}$" long x 4" (btw. conn.)	$12\frac{27}{32}$" long x $4\frac{1}{2}$" (btw. conn.)
Element	$1\frac{1}{16}$" O.D. x $3\frac{15}{16}$" long	$1\frac{3}{4}$" O.D. x $4\frac{3}{16}$" long	2" O.D. x $7\frac{3}{8}$" long
Connections	$\frac{7}{8}$-14 UNF-3B (AND 10050-10)	$1\frac{1}{16}$-12 UN-3B (AND 10050-12)	$1\frac{5}{16}$-12 UN-3B (AND 10050-16)
Indicator Actuation	80 PSI at temperatures over 30° ± 20°F	70 PSI at temperatures over 30° ± 20°F	80 PSI at temperatures over 30° ± 20°F
Maximum Operating Pressure	3000 PSI	5000 PSI	4500 PSI
Maximum Operating Temperature	225°F	275°F	275°F
Weight of Complete Unit	1.8 lbs.	4 lbs.	6 lbs.
Degree of Filtration	25 Microns Absolute	25 Microns Absolute	25 Microns Absolute
Element Withstands	3750 PSI	3000 PSI	500 PSI
Relief Valve Setting	None	None	225 PSI

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA

Purolator Products, Inc.
Dept. AW70, Rahway, New Jersey

____Please send further information on Purolator's exclusive Mechanical Indicator Filter.
____I have enclosed a drawing of my filtration problem. What do you recommend?

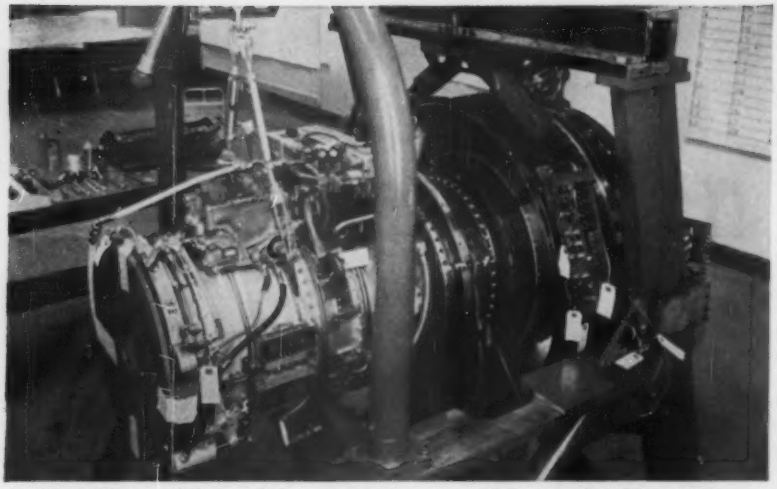
Name _____

Company _____

Address _____

City _____ Zone _____ State _____

Flight Propulsion



CF700, 4000-pound thrust aft-fan engine, has successfully completed its initial series of tests ahead of schedule.

CF700 Testing Begins Ahead of Schedule

LYNN, Mass.—The CF700, G.E.'s first small aft-fan engine, has successfully completed its initial series of test runs ahead of schedule.

Operation was highly satisfactory. Runs checked out the new engine's basic mechanical and operating characteristics. There was no appreciable vibration. Stress, temperature and pressure were well within limits. Control, fuel and lubrication systems functioned without incident. Visual inspection at the end of the test cycle showed all engine parts in excellent condition and operating properly.

For more information on the CF700, check GED-3986. See coupon.

McDonnell F4H Completes Carrier Suitability Trials

ABOARD USS *INDEPENDENCE*—McDonnell's F4H, powered by twin General Electric J79 turbojets, recently completed its carrier suitability trials.

Launched by steam catapult 18 times during the trials, the Phantom II demonstrated that it can operate easily from today's modern U.S. Navy carriers.

McDonnell F4H demonstrated that it can operate easily from carriers like the USS *Independence*.

The Mach 2+ Phantom II demonstrated its ability to fly at slow 125 knot carrier approach speed.

Wave-offs were accomplished on one engine, without using its afterburner. Rapid and reliable response to throttle movement, especially important to carrier operations, was demonstrated. Engine performance and performance of the two paralleling 20 KVA hydraulic constant-speed drives also produced by the Flight Propulsion Division were excellent.

Squadron deliveries of the F4H/J79 will begin later this year.

For more information about F4H/J79 carrier trials, check GED-4106. For constant speed drive information, check GEA-6890. See coupon.

FAA Certificates CJ-805-23/-23A Engines

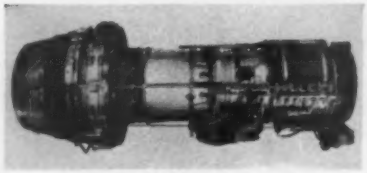
CINCINNATI, Ohio—General Electric received Federal Aviation Agency type certification of two models of its aft-fan engine during June.

The certificate, numbered 1E5, covers the Company's CJ-805-23 engine rated at 15,850 pounds thrust, and the CJ-805-23A, with a thrust of 16,100 pounds. General Electric has been shipping production aft-fan engines to Convair since late April for the 635-mph Convair 990 jet airliner.

Convair 990's are scheduled to enter commercial service in 1961 with American Airlines, Swissair, Scandinavian Airways Systems (SAS), and REAL of Brazil.

The test program accomplished for this certification concentrated on the fan section of the engine, since the basic engine has already been certified by FAA, and is in commercial service. The aft-fan unit testing included operation during overspeed, overtemperature, fatigue, stress, and icing conditions.

For additional CJ-805-23 information, check GED-4117 and GED-4192, latest CJ-805 Progress Reports. See coupon.



FAA has certificated CJ-805-23 and -23A.

Delta Orders 3 More 880's

ATLANTA, Ga.—Delta Air Lines has ordered three additional Convair 880 jet airliners. The General Electric-powered aircraft will be delivered in August and September, 1961. All ten 880 jet airliners first ordered by Delta will be delivered this year.

NEWS

A report about progress in products from the Flight Propulsion Division of the General Electric Company.

Sketch of Kaman HU2K shows how J85 pod mounts to provide boost power.

J85 Boost Promises Increased Helicopter Speed, Lift, Range

WASHINGTON, D. C.—An economical new method of substantially increasing the speed, lift, range, and versatility of newest military helicopters has been announced by the Kaman Aircraft Corporation and the General Electric Company.

The method uses the currently available G-E J85 for boost power and could be ready for flight testing in six months without major development expense.

Engineering studies by Kaman show that addition of the jet boost system to the Navy's newest turbine-powered utility helicopter, the HU2K, would increase speed 40 percent, lift 20 percent, and range 17 percent over the already high levels achieved using the basic General Electric T58 powerplant. Hovering and climb characteristics would also improve.

Detachable pod for the J85 is about 50 inches long, 30 inches in diameter, and weighs 400 pounds. It would be equipped with a simple "plug-in" type connector and could be attached or removed by two men in a matter of minutes. No major helicopter alterations are necessary for adoption of the boost system.

Directional control of the jet exhaust stream could be preset or pilot controlled by rotation of the engine exhaust nozzle to give either maximum horizontal thrust for speed, maximum vertical thrust for lift, or intermediate thrust for boosting both lift and speed. *For more information about the J85 and its many applications, check GED-4095. See coupon.*

New CJ610 Turbojet Offered for Small Executive Aircraft

LYNN, Mass.—A new 2700-pound thrust turbojet for small business aircraft is being offered by General Electric.

Designated the CJ610, this turbojet is a commercial version of the proven military J85, and a companion engine to the 4000-pound thrust CF700 aft-fan engine now on test.

The 355-pound CJ610 is a dry J85 to which have been added the CF700-2 bottom-mounted gearbox and accessory package. Or, in other words, the CJ-610 is identical to the CF700 except a turbojet tailcone replaces the CF-700 aft-fan unit.

CJ610 development will parallel the CF700 program. FAA certification is scheduled for December, 1961.

New CJ610 turbojet produces more power for its size than any existing aircraft powerplant.

Prototype CJ610 engines for flight testing can be delivered nine months from order.

The CJ610 will produce more power for its size than any existing aircraft powerplant. It is only 40 inches long, 17.7 inches in diameter. Guaranteed thrust rating is 2700 pounds.

Together, the CJ610 and CF700 provide a broad spectrum of power for aircraft manufacturers.

If the CJ610 is chosen as the initial powerplant for an aircraft, the CF700 represents the logical follow-on for future growth versions.

The basic J85 gas generator, which is common to the CJ610 and CF700, is already proving itself daily at sea level and at altitude. It will have accumulated more than 50,000 operating hours by February, 1962, when these new powerplants become available.

For more information about the CJ-610, check GED-4208. See coupon.

New Military Aft Fan Provides 22,000 Pounds of Thrust

CINCINNATI, Ohio—A new G-E military aft-fan engine, the MF239C, is designed to produce more than 22,000 pounds of thrust for sub-sonic aircraft.

The MF239C uses a growth version of the operationally proven J79 gas generator and an advanced aft fan.

Engine designers have skillfully matched MF239C by-pass ratio and fan pressure ratio to provide significant turbofan performance improvements for military mission requirements.

Qualified 22,000-pound thrust engines can be available in July, 1963. *For more information, check GED-5005. See coupon.*

FOR MORE DETAILED INFORMATION on these and other developments in General Electric products, contact your nearest G.E. Flight Propulsion Division representative or indicate below the brochures you would like to receive.

General Electric Company
Section A206-12
Schenectady 5, New York

- ☐ GED-3986, "CF700-1 Turbofan"
- ☐ GED-4106, "F4H/J79"
- ☐ GEA-6890, "Constant-Speed Drives"
- ☐ GED-5005, "MF239C Aft Turbofan Power"
- ☐ GED-4208, "CJ610 Turbojet"
- ☐ GED-4095, "J85 Turbojet"
- ☐ GED-4117/4192, "CJ-805 Progress Report"

Name_____

Title_____

Company_____

Address_____

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GENERAL ELECTRIC

MOST ADVANCED OPERATIONAL ELECTRONIC WARFARE SYSTEM FOR OUR ARMED FORCES

For more than a quarter-century, Hallicrafters has worked in close partnership with our armed forces on fast solutions to critical military electronics problems. Example: new airborne Electronic Countermeasures equipments of very advanced design, now being produced to protect our military aircraft. This kind of teamwork continues to pay off for America—in more effective, more reliable, more economical electronic warfare systems.

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Looking for a challenging new opportunity? We are interested in qualified engineers at all levels. For full details in confidence, contact William F. Frankart, Director of Engineering.

Facilities, and Quick Reaction Capability in Airborne, Ground, Naval and Missile electronic systems for countermeasures . . . reconnaissance . . . maintenance and technical support . . . communications.

URGENT PROBLEMS RELIABLY SOLVED

CLEMCO
AERO PRODUCTS, INC.
PUTS A DAMPER ON AIRCRAFT HAZARDS!

A– Rudder — 4 Flutter Dampers — 2 Tab Dampers.
B– Elevator — 3 Flutter Dampers — 2 Tab Dampers.
C– Elevator — 3 Flutter Dampers — 2 Tab Dampers.
D– Aileron — 2 Flutter Dampers — 2 Tab Dampers.
E– Aileron — 2 Flutter Dampers — 2 Tab Dampers.

CLEMCO AERO PRODUCTS *tab and flutter dampers are used on the* **CONVAIR 600** *and* **880.**

TAB DAMPERS

The Clemco Aero Products Tab Damper is used on the flying tabs of the world's fastest commercial jet liners where it serves the important function of flutter prevention.

The important requirements of this application are low static friction, a linear damping constant, zero lost motion and relatively high dynamic stiffness. All of these requirements must be met through a temperature range of +160°F. to –65°F.

The Clemco Aero Products design meets these requirements with a rotary hydraulic damper with a self-contained accumulator and thermal compensation.

Specifications are as follows:

Maximum static friction 1.5 inch-lbs. at –65°F.
Damping constant up to 150 inch-lb./rad/second.
Travel ±40°.
Limit load 660 inch-lbs.
Dynamic stiffness 52,000 inch-lbs./rad.
Fluid MIL-H-5606
Weight 2.77 lbs.
Coupling Provision ½" diameter involute serration Per NAS542-64-31.

The damper has undergone more than a million cycles of oscillation at ±½° amplitude, at a rate of 25 CPS, and extensive thermal cycling with no evidence of deterioration.

The characteristics of low static friction, low inertia, high dynamic stiffness and linear damping, obtainable in this basic design, suggest its use in many applications where mathematically idealized viscous damping is desirable.

Designs to meet your specific application will be supplied on request.

FLUTTER DAMPERS

The Clemco Aero Products Rotary Flutter Damper is used on the control surfaces of the world's fastest jet airliners as well as on many high performance military aircraft.

The primary advantages are space conservations, low static friction and maximum overall system rigidity per pound of structural weight.

Space conservation is achieved by hinge line installations. Low static friction is a necessity for proper operation of a control system and is achieved by having the friction of the dynamic seals acting on a moment arm of approximately one-half inch.

Maximum system rigidity is attained by spanning a minimum amount of structure between the damper terminals. Since energy dissipation is limited by system rigidity, great savings in structural weight can be achieved by the use of rotary dampers.

The Clemco Aero Products Flutter Damper is a self-contained, temperature compensated, rotary hydraulic damper with integral shaft and housing vanes, and a visual fluid level indicator.

Three basic sizes are now in production and have been fully qualified.

Dia.	*Max. Damping Constant in in-lb/rad/sec.*	*Dynamic Stiffness in-lb/rad.*	*Angular Travel*	*Coupling Serration Diameter*
1.50	550	163,000	±30°	.875
1.75	1,400	235,000	±35°	1.00
2.00-1	2,000	345,000	±35°	1⅛
2.00-2	1,200	300,000	±47.5°	1⅛

All maximum damping constants are at +160°F. and can be increased if desired at lower temperatures. The length of all units is approximately 7" and the static friction approximately 6 inch-lbs.

Dampers with characteristics other than the above can be supplied with a relatively short lead time.

Although these units were developed for flutter prevention, the stringent requirements of this application qualify them for use wherever a quality damper is required.

CLEMCO AERO PRODUCTS, INC., THE WORLD'S LEADING PRODUCER OF PROVEN ROTARY TAB AND FLUTTER DAMPERS, ALSO FURNISHES THE LEADERS OF THE AIRCRAFT AND MISSILE INDUSTRY WITH:

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DENVER, COLORADO

Sikorsky S-62 demonstrates 2,000-pound payload delivery in the Himalayas at 14,000-foot altitude.

The Sikorsky S-62 can hover... and then deliver, with pin-point precision, a 2,000-pound payload at 14,000 feet. This far exceeds the performance of helicopters of the S-62's weight class, and actually *betters* the performance of much larger helicopters. The turbine-powered S-62 thus opens new horizons for high altitude exploration, construction and supply—major news for helicopter operators.

Altitude capabilities are only *one* of the many unique features built into this boat-hulled turbocopter. It takes off and lands almost anywhere—land, water, shipboard, marsh, tundra, ice, mud. Find out more about the S-62's economies and operating features. Call or write Sikorsky today.

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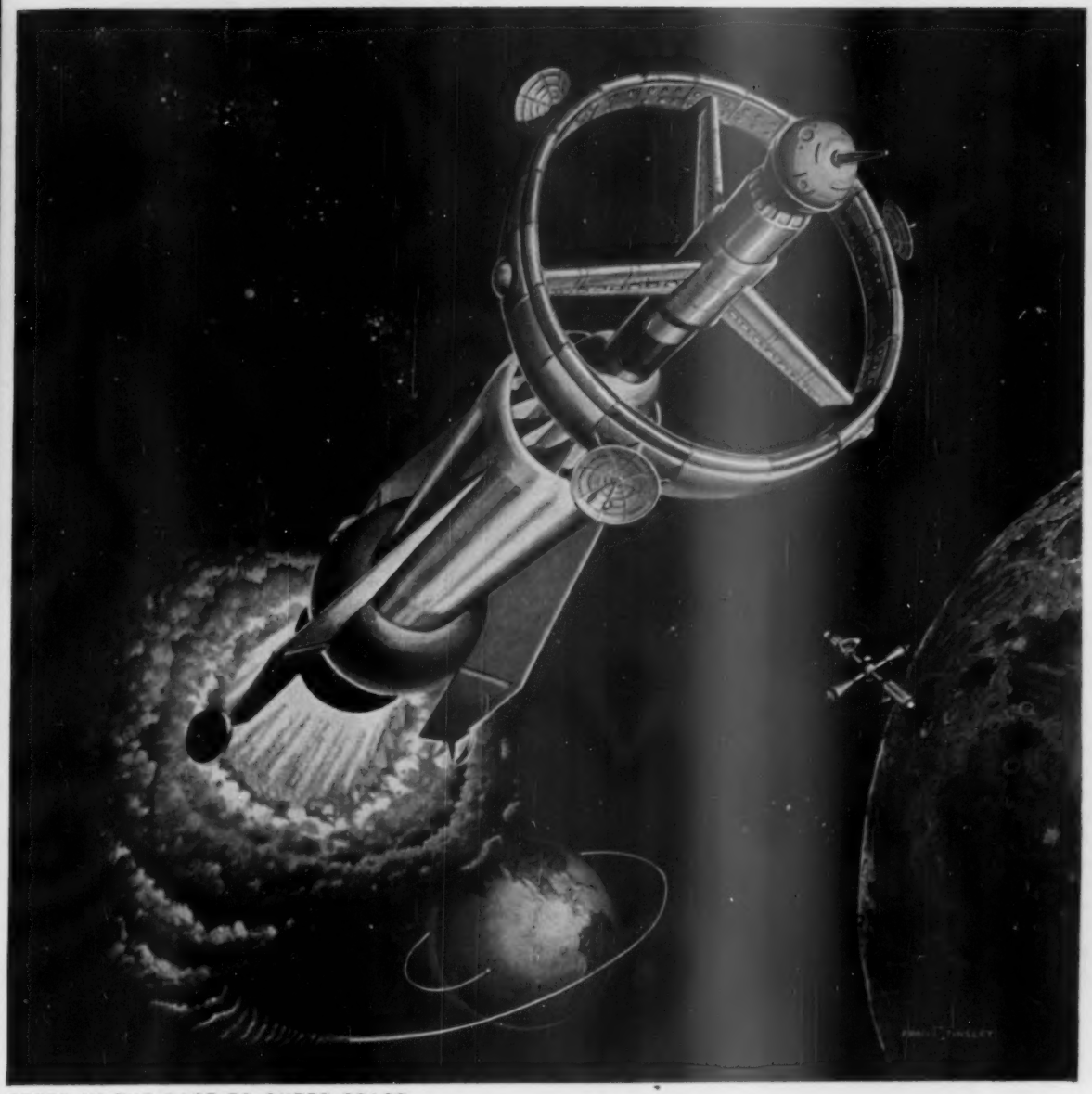

STEPS IN THE RACE TO OUTER SPACE

Atomic Pulse Rocket

This is the Atomic Pulse Rocket, a pot-bellied space ship nearly the size of the Empire State Building, propelled by a series of atomic blasts.

The enormous rocket (weighing 75,000 tons fully loaded) is designed to leave Earth with a thrust of 100,000 tons. Altogether a thousand atomic blasts—each equal to 1,000 tons of TNT—are fired from a low velocity gun into a heavy steel rocket engine at a rate of one per second until the vehicle leaves Earth's atmosphere. Then steam and vaporized steel maintain the thrust. After transit speed is reached, and the propulsion system shut off, power is provided by solar batteries plating the wing and body surfaces.

Inside the rocket, living quarters are situated in the rim of a pressurized wheel-like cabin which revolves to provide artificial gravity. Radio and radar antennae revolve with it. Tubular hydroponic "gardens" on either side of the rim grow algae to produce oxygen and high protein food.

The Atomic Pulse Rocket could transport payload to the Moon at $6.74 per lb., less than one quarter the prevailing air freight charges over equivalent distance.

A similar project is past the pilot-study stage in the Defense Department.

ARMA, now providing the inertial guidance system for the ATLAS ICBM and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, ***ARMA*** needs scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

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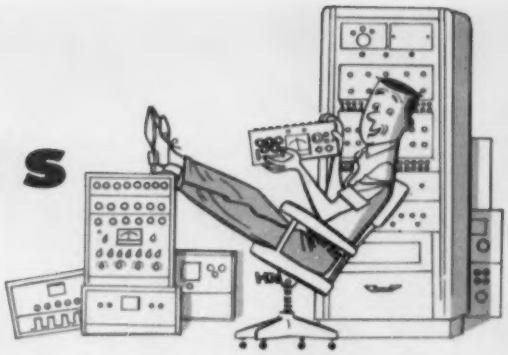
ANALOG COMPUTERS

—How You Can Use Them



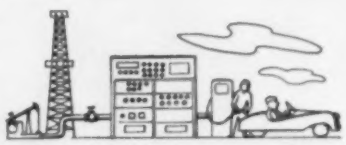
It's no secret that people who make analog computers spend a lot of time talking to each other. Pity the chap who's trying to figure out how all this palaver applies to him. He's in a semantic jungle.

First, let's define what kind of computers we're talking about. At Donner, we're concerned with two types—general purpose and fixed purpose. Quickly, general purpose analog computers solve equations describing lumped parameter, dynamic systems expressed in linear or non-linear differential equations, or transformed (La Place) equations. They are used to directly simulate systems described by these equations. They are also used to analyze sections of these systems. In other words, this type of computer gives you freedom and flexibility limited only by your imagination.

THE FIXED PURPOSE COMPUTER

Actually, there's not much difference between general purpose and fixed purpose computers. The point is that fixed purpose computers fit neatly into your system to do a specific job. You don't have to worry about programming—that's built in. All you do is turn the knobs. It may interest you to know that 80 to 90 per cent of analog computing equipment sold is fixed purpose. At Donner, fixed purpose gear is one of our big specialties. It comes in a wide variety of sizes. Typical of lightweight devices is the solid state "think" device developed by Donner for the Polaris missile which monitors flight performance. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a predetermined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Another fixed purpose computer is the on-line wind tunnel data reduction computer recently built by Donner for the National Research Council of Canada. This computer receives, processes, and analyzes signals from force transducers mounted on a scale model. Such coefficients as lift and drag are continuously and simultaneously studied.



COMPUTERS FOR ANALYSIS ARE OFTEN USED

Fixed purpose analog computers are used in linear and non-linear programming. Here, they solve problems of gasoline blending, game theory, logistics, military tactics, and operations research.

Other fixed purpose analog computers are used to study spectral density and variation coefficients. The spectral density computer is used to make vibration, noise and system transmissibility studies. Statistical evaluation of non-continuous or discrete process can be performed with variation coefficient computers. In this application, achieved values are put in and average value, standard deviation, and variation coefficient instantly computed out.

COMPUTERS FOR INFORMATION CONTROL, SIGNAL CONDITIONING, AND PROCESSING

Three other examples of fixed purpose analog computers in use are a missile tracking computer, signal conditioning computer, and process control computer.

The missile tracking computer receives distance and angular displacement information from tracking radars. From this information, the computer provides a continuous plot of the missile's position in cartesian coordinates.

Signal conditioning computers modify frequency, phase or amplitude to restore or control signal characteristics. They are used for hybrid computer links, preamplification of low level transducer signals, spectrum segmentation with active filters, or automatic control of dynamic range.

Process control computers receive signals from transducers, linearize the signals, compare them with set points both fixed and variable, and provide control signals with rate, reset, and proportional adjustments.

Enough talk. We've given you a rough idea what Donner has done for other people. Let's find out how this applies to you. Send us a brief description of your problem; a paragraph or two will do. We'll write back telling how Donner can help and send you a Tech Note if it applies. If writing's a chore, our engineering rep will be happy to discuss methods of solving your problem with Donner's computer systems. Just contact us for his name. Either way, you'll get information that applies to your particular problem. Please address Dept. 09.

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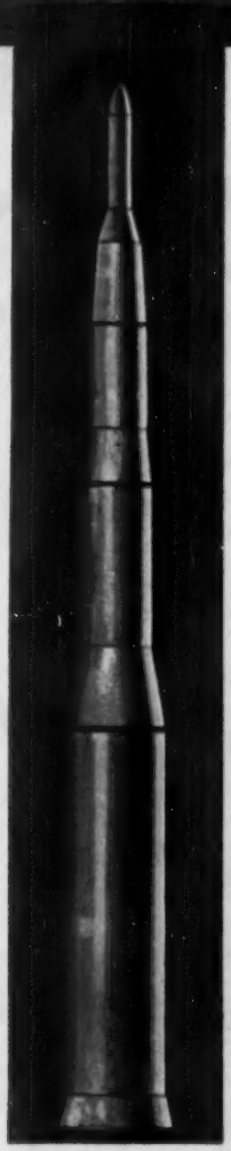
CONCORD, CALIFORNIA

SEE US AT WESCON

26



SEALED IN A SECRET SILO

Somewhere in a wasteland, the Air Force Minuteman will keep its lonely vigil all through a thousand nights. Buried and untended, it must be ready to spring to life if the button is ever pushed.

Minuteman poses a real challenge to the New Reliability—reliability which must guarantee successful firing at any moment in the far future. Each of the missile's systems, each of its thousands of electronic components, must function perfectly at that given moment. For once the missile is lowered into its silo, no human hands again need touch it.

The Minuteman's critical guidance and control system has been entrusted to Autonetics. We are proud to be a member of this United States Air Force missile team.

Once again America's defense force reaps the harvest of Autonetics' pioneering. A decade of experience with major projects has given Autonetics a unique capability in systems management—and in meshing its work with that of other companies in building modern weapon systems.

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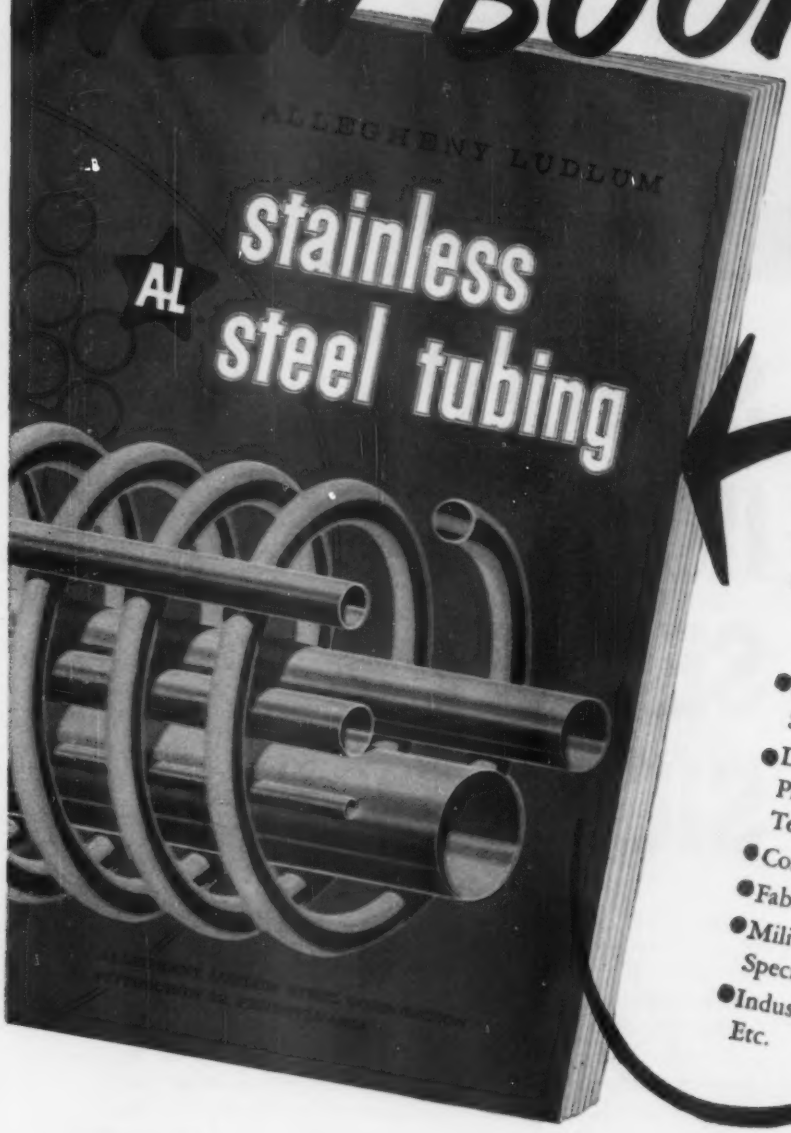
INERTIAL NAVIGATION / ARMAMENT AND FLIGHT CONTROL / COMPUTERS AND DATA SYSTEMS

NEW BOOKLET on STAINLESS STEEL TUBING sent on request



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- Stainless Steel grades
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- Size range Stainless Pipe & Tubing
- Design data—Internal Pressures—Elevated Temperatures, etc.
- Corrosion resistance
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Etc.

This 36-page booklet newly published by Allegheny Ludlum is packed with technical data and authoritative information on both welded and seamless stainless steel tubing. There are more than 20 tables for ready reference and many photographs.

It will be helpful to design engineers and others interested in solving the many critical and demanding pipe and tubing applications.

The booklet contains the best and latest information available on product and design data on the subject—the partial contents listed give some idea of its scope. You'll want a copy for your files.

Write for your free copy of Allegheny Stainless Steel Tubing, ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AW-7.***

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FOR LIQUID HYDROGEN VESSELS

STANDARD-Cambridge, under license from National Research Corporation, is now using the newly-developed "super" insulation NRC-2 in its equipment for storing and transporting such hard-to-contain cryogenic fluids as liquid helium and liquid hydrogen.

NRC-2 is a multiple barrier reflective insulation operating under high vacuum. Tests by National Research, government and university laboratories, and the STANDARD facilities at Los Angeles, Decatur, Illinois and Lowell, Massachusetts have established its thermal efficiency.

REDUCES HEAT LOSSES

NRC-2, when compared with equal thicknesses of 80-mesh perlite, allows only 1/35.7th as much heat leak. Performance records show NRC-2 to have the lowest heat transfer co-efficient of any cryogenic insulation now known. "k" factors as low as 0.28 micro-watts per cm° between room (ambient) temperature and liquid nitrogen (.1618 x 10^{-4} BTU/hr/ft²/ft/°F) have been produced.

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NRC-2 weighs 71.5% less by volume than perlite. Payloads are thus easily increased and important economies in overall dimensions can be effected because of the reduced annular insulation space required.

Through its high efficiency, NRC-2 cryogenic insulation can eliminate the need for a costly protective jacket of nitrogen. This factor alone could reflect considerable savings on operation and maintenance of storage equipment.

COMPLETE CRYOGENICS LINE

STANDARD-Cambridge now can provide NRC-2 insulation on its complete line of cryogenic equipment for the transportation and storage of ultra-low temperature liquefied gases. Contact the STANDARD plant nearest you for complete information.

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STANDARD-Cambridge Equipment is serving such projects as Atlas, Thor, Jupiter, Redstone and Titan.

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COVER—Strategic Air Command missile crewmen mate General Electric Mark 3 re-entry vehicle to dummy of USAF-Convair Atlas intercontinental missile in training exercise at Warren AFB, Wyo. Cradle in which nose cone was lifted to mating position is part of re-entry vehicle transportation and lift trailer, an item of nose cone ground support equipment furnished by GE. Cradle has been opened and lowered back almost to normal position on trailer. It is rubber-lined and grips nose cone tightly enough to allow no slippage during transportation and mating operation. (See other pictures on pp. 48-51.)

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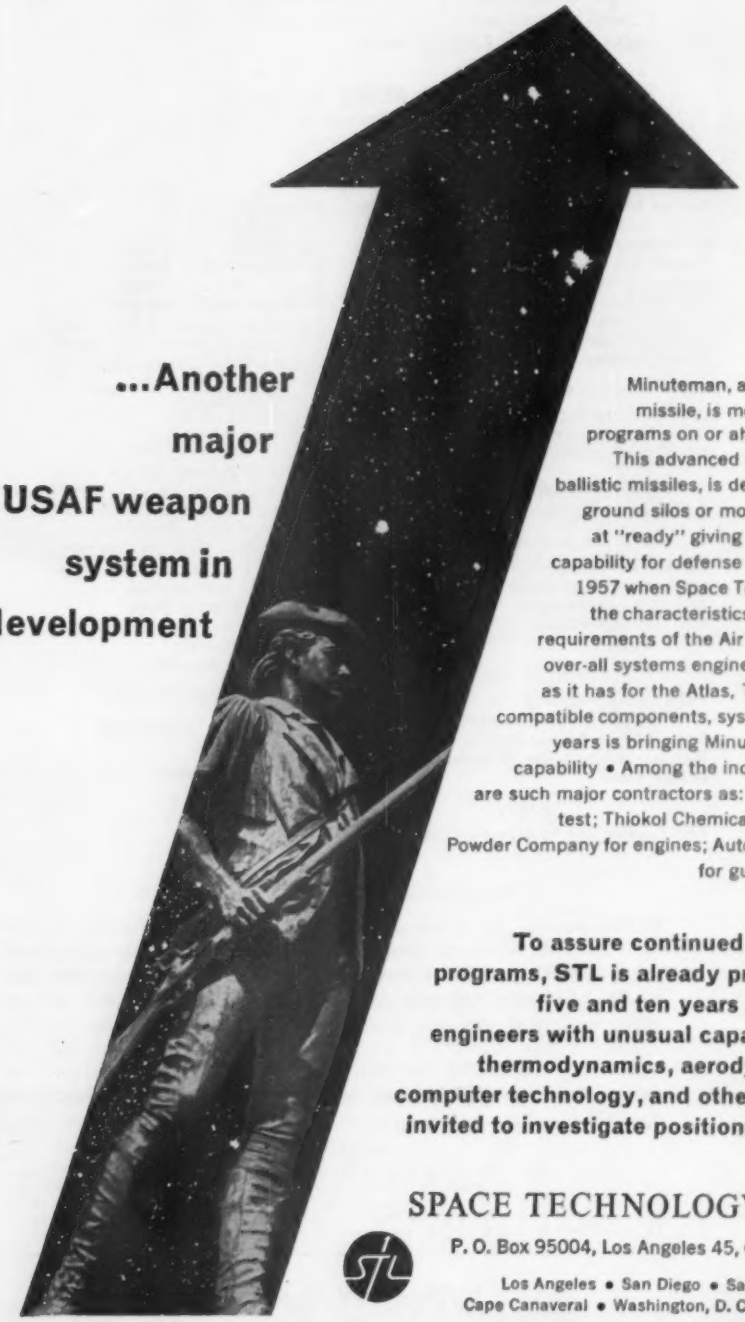
Minuteman



...Another major USAF weapon system in development

Minuteman, a three-stage solid propellant intercontinental missile, is moving through its early development and test programs on or ahead of the time schedule originally set for it. This advanced ICBM, the fourth in a family of four Air Force ballistic missiles, is designed to be fired automatically from underground silos or mobile launchers. Minuteman will be constantly at "ready" giving America an almost instantaneous retaliatory capability for defense • The Minuteman concept developed early in 1957 when Space Technology Laboratories conducted a study of the characteristics of second-generation missiles to satisfy the requirements of the Air Force Ballistic Missile Division. STL provides over-all systems engineering and technical direction for Minuteman as it has for the Atlas, Titan, and Thor programs. The application of compatible components, systems, and experience developed through the years is bringing Minuteman closer to the threshold of operational capability • Among the industrial organizations developing Minuteman are such major contractors as: Boeing Airplane Company for assembly and test; Thiokol Chemical Corp., Aerojet General Corp., and Hercules Powder Company for engines; Autonetics, a Divisionof North American Aviation for guidance; and Avco Corp. for re-entry vehicle.

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EDITORIAL

The American Challenge

(The following remarks by Dr. James R. Killian, Jr., chairman of the Massachusetts Institute of Technology Corp., should have special significance for every American contemplating his country's future on this 184th anniversary of the Declaration of Independence. They are delivered as part of the charge to the 1960 graduating class of MIT at the institutes 94th commencement exercises at Cambridge, Mass., last month. Dr. Killian served as President Eisenhower's first scientific adviser in the post-Sputnik period.)

Today, every informed man who has the opportunity is under obligation to speak out on the urgent issues confronting us and thus to contribute to the public thought and the national discourse—but to do so responsibly and temperately.

In this spirit, let me comment on a few issues currently under lively discussion. It is difficult to preserve a spirit of moderation and restraint in the face of the jolting events in Paris and the gross incivilities that subsequently have occurred, but we may all be heartened that the nation and the leaders of both parties have on the whole reacted with dignity, restraint, and maturity, even though everyone cannot fail but be saddened by the grim prospect of continuing an intensified cold war. Fortunately there has been almost a consensus that great national poise and maturity under these circumstances can achieve heightened esteem for the nation and can strengthen its moral leadership.

Even though there has been a setback in foreign relations, we cannot afford to lose faith in the possibility of relieving tensions, reducing armaments, and shaping a better world order. More than ever now our nation has the privilege as well as the obligation to demonstrate to a watching world the moral commitment of our democracy to persist in seeking solutions to these problems, including the construction of a lasting framework for peace.

In a recent trip around the world, I encountered impressive evidence of good will toward the United States. At the same time, I found informed and friendly people who feel that we are not realizing our full potential either in our domestic development, in carrying the American revolution into its next and greater phase, or in the exercise of our international leadership.

Leadership Expected

We must accept the sobering fact that much of the world looks to the United States for leadership in all ways, but especially does it look to us for moral and intellectual leadership. It "expects of us a certain height" and it grows critical when we fail to measure up simply because it expects more of us than of other nations.

At this moment, we should have the height and the firmness of purpose not to be cynical or pessimistic about the possibilities of reducing tension and in achieving agreements on safeguarded arms limitation. Men everywhere will hope that we do not yield in our determination to make headway toward these goals, even though the way is slow and vexing and marked by rebuffs, and even though negotiation requires a patience greater even than Job's. It requires better governmental organization and preparation than we have had.

We should also not slacken in our determination to be militarily and economically strong. This is still, in my view, the basic requirement to deter war and to give a sense of confidence and stability to the free world. We now have great military strength, but there remain aspects of our defense program which are of great concern.

I am one of the many who feel that we are deficient in limited war capabilities. We need better public understanding of the need to make our nuclear striking power more invulnerable and to supplement it with adequate strength to deter non-nuclear limited war. Another area of legitimate concern is the absence of any real program of civilian defense. In both limited war capability and civilian defense we have failed so far to achieve an adequately secure deterrent.

Despite all the furor following the U-2 failure, we should not let ourselves be maneuvered into stopping comparably useful intelligence operations. So long as the iron curtain exists, so long as open skies have not been achieved and threats hang over us, we cannot draw back from defending ourselves and the free world against surprise attack. The U-2 episode, unfortunate as it was, should not weaken our will to create and employ alternate means such as satellites to provide us with warning. No one who has looked at all the facts, in my judgment, can fail to conclude that such intelligence information is an inescapable requirement of our responsibility to serve as the shield of the free world. We can hope and work for the achievement of a world of open skies when clandestine operations become unnecessary.

Greater Efforts Needed

Much remains to be done in behalf of national security, and what remains to be done cannot be accomplished without larger efforts and greater sacrifices than we have yet accepted. This is also true of foreign aid. It seems incredible that a policy so essential to the strength and stability of the free world should be so precariously supported.

Much remains to be done also in behalf of education. We have talked much and acted less, for example, with respect to strengthening our public schools.

America's future economic strength as well as its national security depend upon its scientific and technological leadership. American technology and industry now face as never before, able, alert, determined competition from abroad. They also face the domestic challenge of maintaining a growing economy, an increasing standard of living, and a higher level of productivity over a broader front than in the past.

Day by day it becomes clearer that we have not yet fully mobilized our scientific and technological resources, that we must achieve enough first-rate facilities and superbly educated scientists and engineers if we are to sustain our technological and industrial leadership and quicken our economic growth. The failure of the summit conference has revealed anew the urgent need still further to strengthen our science and technology.

These aspects of peace, defense, foreign policy, and home affairs are but a sample of the items of urgency and unfinished business on our national agenda. It is a time requiring steady advance to a higher performance in all aspects of our national life.

Today, a shift seems to be under way in the order of priority the public places on these items on our national agenda. Running deeper than any political bias or party position, there is a desire to re-examine and re-affirm our national goals. There is a sense of expectancy that we can move into the next and still greater stage of the American revolution. There is conviction that if our nation is to solve these problems on the national agenda, every part of it must be strong, forward-thrusting, and of the highest quality. Every state, every city, every school, every individual must share the responsibility to contribute to the national strength and greatness.

D DAY, THE LACK OF RECONNAISSANCE AND A FAULTY COMMAND DECISION

At 10:15 p.m., June 5, 1944, Lieutenant Colonel Meyer, counter-intelligence chief of the Fifteenth German Army burst into his commander's dining room, interrupting a relaxed game of cards. He held a message intercepted from Allied Headquarters, a message the German General Staff knew meant Allied invasion within 48 hours! But the card game placidly continued. Reason: no reconnaissance verification. Though a 5,000 ship, 20 mile wide invasion fleet clogged the English Channel, not a single Luftwaffe plane reported this progress. And so Field Marshal Rommel, commander of German forces in the area, was not notified until after H hour and remained on leave in Germany. Later, urgent pleas for panzer divisions in reserve near Paris were rejected by higher authority in Germany who thought the Normandy invasion was merely a diversion.

Why such confusion, particularly when Rommel's military tactics included the study of Confederate generals with their dependence on the swift reconnaissance "eyes" of J.E.B. Stuart's cavalry? Answer: unlike the reconnaissance-wise Confederates, Rommel's "eyes" were obsolete for their day... fighter aircraft, modified for the important reconnaissance mission. Result: lack of reconnaissance... D-Day success for the Allies.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

CHICAGO AERIAL INDUSTRIES, INC.

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OTHER DIVISIONS: KINTRONIC, CHICAGO AERIAL SURVEY, Franklin Park, Illinois; PACIFIC OPTICAL CORP., Inglewood, Calif.

WHO'S WHERE

In the Front Office

Roy E. Marquardt, president of Marquardt Corp., elected a director of Systron-Donner Corp., Concord, Calif.

Arthur P. Jacob, board chairman, Pacific Automation Products, Inc., Glendale, Calif., succeeding **Frank G. Jameson,** now president of the Navy League of the United States.

C. Hart Miller, chief executive officer of The Sierracin Corp., Burbank, Calif.

William W. Wood, president, Link Division of General Precision, Inc., Binghamton, N. Y., succeeding **David D. Mason,** resigned.

Dr. William S. Partridge, president, Utah Research & Development Corp., Salt Lake City, Utah, a subsidiary of Interstate Engineering Corp. Also: **Dr. Emerson Cannon** and **Dr. Wayne S. Brown,** vice presidents.

Joseph J. Bokan, president, International Telephone and Telegraph Corp.'s Components Division, Clifton, N. J.

Doane R. Gero, president, Information Systems, Inc., Los Angeles, Calif., succeeding **Gifford K. Johnson** who will return to Chance Vought to resume his duties as an officer of the parent corp.

Dr. H. Igor Ansoff, vice president for plans and programs, Lockheed Electronics Co., Plainfield, N. J., a subsidiary of Lockheed Aircraft Corp.

Dr. James H. Fisher, a vice president, Electro-Optical Systems, Inc., Pasadena.

Dr. Ralph P. Johnson, vice president, Electronics Divisions, Thompson Ramo Wooldridge, Inc., Canoga Park, Calif. Vice President **Milton E. Mohr** succeeds Dr. Johnson as general manager of Ramo-Wooldridge, a division of Thompson Ramo Wooldridge, Inc.

Raytheon Co., Waltham, Mass., has elected the following as vice presidents: **Glenn R. Lord,** general manager, Equipment Division; **Fritz A. Gross,** assistant general manager, Equipment Division; **Thomas L. Phillips,** assistant general manager, Missile Systems Division.

Dr. William L. Whitson, a vice president, The Martin Co., Baltimore, Md.

Dr. Seymour Cohn, vice president and technical director, Rantec Corp., Calabases, Calif., succeeding **Dr. Robert S. Elliott,** a professor at UCLA, who will continue with Rantec as a consultant.

Henry Petronis, vice president-manufacturing, Pall Corp., Glen Cove, N. Y.

Cecil W. Moore, assistant vice president-traffic and sales administration, Pan American World Airways.

Karl F. Kellerman, assistant to the executive vice president of The Bendix Corp., Detroit, Mich.

Mohawk Airlines has retained **Walter Sternberg** to develop and direct the company's traffic, sales and public relations. also: **Russell V. Stephenson,** vice president-customer service.

The National Science Foundation and the University Corporation on Atmospheric Research have announced the appointment of **Walter Orr Roberts,** of the High Altitude Observatory, Boulder, Colo., as director of a newly created National Center of Atmospheric Research.

(*Continued on page 97*)

INDUSTRY OBSERVER

► Development of a gun which can fire solid particles at velocities substantially in excess of 20,000 fps. is urgently required by NASA. Several high-velocity guns now fire projectiles at close to this speed, but much higher velocities are necessary to completely understand hypervelocity impact and explosive cratering phenomena, which is vital to anti-missile work and long duration space flight.

► **Micrometeorite satellite will be one of the early NASA Scout vehicle payloads. Langley and Lewis Research Centers and Goddard Space Flight Center will share space, using three different methods to determine puncture rates, which vary with the number of hits, frequency of hits, area affected and thickness of material. Later micrometeorite experiments may test puncture rate on areas as large as 20 or 30 sq. ft.**

► Rocket motor for Navy's Subroc underwater-air-underwater nuclear-armed missile will have four nozzles.

► **Technique that greatly reduces vulnerability of radar to enemy jamming by instantly and automatically shifting radar to a different frequency which is clear of jamming has been developed by General Electric's Light Military Electronics Department. GE has proposed to Air Force and Navy a 20-lb. adapter which could give existing interceptor fire control systems the new "frequency agility." Navy will evaluate the unit on a radar modified by GE.**

► Blackout of high frequency radio communications in the Arctic, which is a serious handicap to military operations there, may be overcome through technique developed by Avco. Working under sponsorship of ARDC's Electronics Research Directorate, Avco has discovered a great increase in the sporadic E-layer of the ionosphere following a solar flare. E-layer appears suitable for reflecting HF signals during the period when the normal reflecting surface, the F-layer, has disappeared because of the solar flare.

► **General Electric J79 engine, in use in more supersonic aircraft than any other turbojet, has amassed slightly more than 500 hr. of flight time at Mach 2.0 and above in its 100,000 hr. of military service. More than 15,000 of these hours have been above Mach 1.0. None of the aircraft powered by the J79 cruise for long above Mach 1.0 on a single mission. Combat time at high speeds is short, and most of the time above Mach 1.0 is spent accelerating to combat speed.**

► E. I. du Pont de Nemours & Co., largest U. S. chemical producer, apparently is reconsidering desirability of seeking rocket propellant work. Company now has 25 technical employes doing research on exotic solid propellants of the fluorine-boron types. Du Pont is believed to be actively seeking a government contract which, among other things, would give it access to data already compiled by others in this field.

► **Flexible metal parachutes capable of withstanding 1,800F temperatures for two to four minutes are being studied by USAF for use in satellite re-entry. Metal fabric would be tightly woven from finely drawn wire. Existing nickel-chromium and cobalt-chromium alloys are believed to be adequate without new development work.**

► Van Zelm Associates has developed aircraft arresting gear for emergency use that absorbs energy by deforming steel tape into the plastic range beyond its yield point. USAF and Navy have completed preliminary tests. Aircraft is arrested when it catches cable and pulls steel tape through a series of rollers. Initial cost is very low, but tape cannot be reused, and system would be uneconomical if used constantly.

► **Aerolab Development Co. has delivered 5-in. spherical rocket motors to National Aeronautics and Space Administration for use as last stage of a six-stage downward firing rocket that will test ballistic missile and space vehicle re-entry at velocities up to 24,000 fps. (AW Oct. 26, p. 54). Spherical motors will see considerable use in spacecraft.**

HOW THE SILICONES MAN HELPED AMERICA KEEP ITS DATE WITH THE JET AGE

As your jet air liner streaks aloft today, UNION CARBIDE Silicones are aboard to help. Silicones aided in its manufacture, too. The giant tires slipped easily from their original molds because of silicone mold release agents. Polyether foam seat cushions were formed under the near-ideal control of silicone surfactants. Soft, flexible oxygen masks, of oxygen- and ozone-resistant silicone rubber, fit facial contours without irritating the skin. Silicone fluids damp out vibration in vital, sensitive instruments. Silicone rubber door seals never lose resiliency even in extreme temperatures, won't harden or shrink. This constant flexibility makes it the basic material in blankets used for construction of honeycomb structural panels, also in grommets, gaskets, and O-rings. And in the flexible hoses in hot-air jet-engine starters. You'll find jet aircraft radio and radar wires insulated with electrically resistant silicone rubber. Piston plane and helicopter ignition wiring, too. Also the boots for helicopter control sticks, many other parts. This is only a smattering of what silicones have been doing for just one industry—aviation. Is your business enjoying equal benefits? We suggest you contact the UNION CARBIDE Silicones Man. Address: Silicones Division. Dept. GA-0002, Union Carbide Corporation, 270 Park Avenue, New York 17, New York.

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UNION CARBIDE SILICONES

Washington Roundup

Satellite Policy Shift

Defense Department will put experimental Midas early warning and Samos reconnaissance satellites into low-inclination orbits that will avoid Soviet territory. State Department and White House favor the move as a result of the effects of the recent U-2 incident.

This policy may furnish the Soviet Union with a precedent for an effort in the United Nations to ban operational Midas and Samos satellites from crossing its border.

The cautious Administration move comes as a surprise, since the Russians did not object to having the Tiros meteorological satellite cross their territory. Soviets expressed suspicions that there is a hidden high-definition camera in Tiros, but they raised no major objections to the project. Russia was the first nation to show that territorial sovereignty doesn't extend into space when it put Sputnik I in orbit.

Defense Department also has abandoned a plan to install Midas and Samos telemetry antennas in Pakistan and other countries near Russia. Shipboard installations may be used instead. This shift undoubtedly stems from the uneasiness in these nations over U.S. reconnaissance programs that was aroused by the U-2 incident.

Congress decided to quit last week and return after the political conventions to finish its work. A drive to complete its business before the conventions was wrecked by controversy over a number of politically-hot bills.

The extra session will give the Senate more time to consider changes in the Space Act proposed by the Administration and already passed by the House.

Research Dispute

Top Air Force research officials are moving to correct problems damaging the morale of civilian scientists in the Office of Scientific Research. Dr. Courtland Perkins, assistant secretary for research and development, recently told ARDC Commander Lt. Gen. Bernard A. Schriever to give his personal attention to disputes between OSR and the new ARDC Research Division. OSR has felt that poor administration by the division is crippling USAF's basic research effort.

Now USAF Chief Scientist Dr. Alexander H. Flax has taken a hand by criticizing USAF's defensive argument that support of basic research is stronger than ever. Dr. Flax wrote Lt. Gen. Roscoe C. Wilson that the work being done by OSR is precisely the type that should be supported by USAF.

Dr. Flax suggested that a civilian manager might be appointed to run the research division instead of a military man.

Perkins has told the civilian scientists to keep their collective shirt on until their problems can be straightened out. Meanwhile, 12 civilian scientific jobs that were to have been shifted from OSR to division level have been put in escrow. If the OSR procurement division is shifted to the research division on July 15 as scheduled, OSR strength will drop from 101 a short time ago to 57 employes.

ARDC has named Arthur G. Wimer, Jr., to the new job of chief scientist, the top civilian adviser to Lt. Gen. Bernard A. Schriever. Wimer will head the ARDC Technical Management Council, and he will be responsible for maintaining good relations between the command and the scientific community. A former assistant to deputy chief of staff research and engineering, Wimer will hold the job for two years.

More Airlift Analysis

Defense Department is forming an advisory committee to analyze military transport proposals and determine whether they meet service requirements. Ad hoc group will serve under the Advisory Panel on Aeronautics in the office of Defense Director of Research and Engineering, Dr. Herbert York.

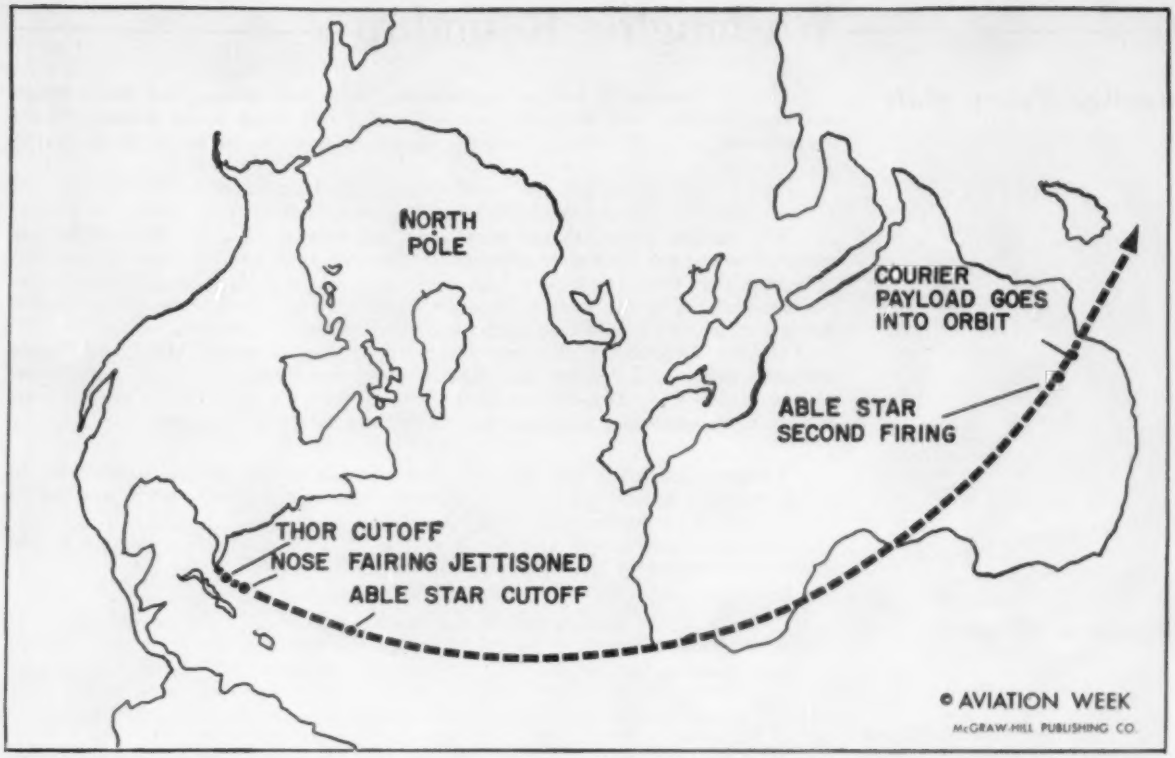
Air Force plan of encouraging development of new military-civil transports by negotiating airlift contracts with carriers buying advanced cargo aircraft is stalled at Defense Department level. House Military Government Operations Subcommittee headed by Rep. Chet Holifield is pressing Defense for a decision.

Notice composed by a NASA Research Advisory Committee as it went out of existence:

Situation wanted: Seasoned technical advisory committee seeks affiliation with congenial permanent government agency, preferably in non-aeronautical field. Complete with chairman, secretary and extensive file of resolutions to suit any occasion. Distinguished membership composed of nationally recognized experts, specialists in obsolete technologies and university professors. Will travel (in mild climates).

P. S. Our former employer knows of this ad.

—Washington Staff



POLAR PROJECTION shows how Courier IA delayed repeater communications satellite will be fired in a southeasterly direction from Cape Canaveral, Fla., passing over the Atlantic Ocean and Africa. Key events are shown along the satellite's trajectory.

Space Technology

Courier IA Launch Set for July 15

Able Star is expected to boost delayed repeater communications satellite into 650 naut. mi. orbit.

Washington—Courier IA communciations satellite, incorporating delayed-repeater and real-time transmission capability, is scheduled to be launched July 15 from Cape Canaveral, Fla., into a 650-naut.-mi. circular orbit. The experiment is an initial research effort leading to a sophisticated chain of communication satellites in the global network capability envisioned for Project Advent, or Comsat.

Key aims of the program will be to test the reliability and operation of critical experimental avionic components under the rigors of prolonged exposure to space environment, with particular emphasis of the system's message capacity, error rate, and signal propagation characteristics. Operational life of the payload is expected to be at least one year.

Characteristics of the Courier IA communications satellite experiment include the following:

• **Spherical payload,** about 50 in. in diameter, will weigh approximately 475 lb.

• **Payload shell** will be constructed of a fiber glass honeycomb sandwich, less than ½ in. thick, and having an aluminized coating. Inner structure supporting the spherical shell consists of four upper and four lower tubular metal truss members running from the upper and lower hubs to a center, equatorial shelf. A metal tube runs vertically through the center of the sphere to give the payload adequate rigidity against launch forces.

• **Avionic equipment** is supported on three shelves—the equatorial shelf and upper and lower platforms attached to the tubular truss members. Four whip-type VHF antennas extend from Courier IA's external equatorial band. Also located on the band will be microwave antennas contained in small housings extending only a short distance from the band surface.

• **Approximately 20,000 solar cells,** probably the greatest number ever carried into space by a U.S.-launched satellite, will be positioned on the payload's external surface in curved triangular patterns, converging to apex points at the hubs. The solar cells will charge nickel-cadmium batteries to power the avionic equipment.

• **Thor-Able Star vehicle** will be launched from Air Force's Missile Test Center, Cape Canaveral, Fla., in a vertical position with downrange heading of about 110 deg. Shortly thereafter, the missile will be put into a 20-deg. roll to a 90-deg. flight azimuth, then put into a gravity turn along the predetermined trajectory. This will take it across the Atlantic southeasterly with the vehicle passing over the vicinity of Cape Verde Islands, southwestern parts of French West Africa and French Equatorial Africa, the Belgian Congo, Rhodesia and Mozambique, for injecting the pay-

load into orbit just before the vehicle crosses the east coast of Africa.

While Thor-Able Star is the same boost vehicle used for the 270-lb. Transit navigation-aid satellites (AW June 27, p. 26), Courier's heavier payload and higher orbit will require substantial change in trajectory sequencing, including about 2 sec. longer burning time for Thor, 11 sec. longer burning time for Able Star, about 14 min. more coast time, but about 5 sec. less time for the Able Star second burning period. Characteristic speed of Able Star for Courier will be about 5,050 fps.—about 75 fps. slower than Transit's Able Star speed.

Launch Sequencing

Launch sequencing for Courier IA will be composed of the following main events:

- **T plus 140 sec.**—Vehicle's pitch program is completed.
- **T plus 165 sec.**—Thor booster propulsion is cut off.
- **T plus 168 sec.**—Able Star burning is initiated. Less than a second later, explosive bolts are blown and the Able Star vehicle is separated from the Thor booster. Able Star is controlled by Space Technology Laboratory's automatic guidance system in conjunction with a Burroughs J-1 computer at Air Force Missile Test Center. Command cutoff signal from ground stops Able Star burning when the vehicle attains its programed speed.
- **T plus 225 sec.**—Able Star nose fairing is jettisoned.
- **T plus 458 sec.**—Able Star burning is cut off and the vehicle begins its coast period which continues until programed altitude is attained for injection of the satellite into orbit. During coast period, pneumatic controls provide stabilization for roll, yaw and pitch axes.
- **T plus 2,405 sec.**—Able Star is fired for the second time, burns for about 9 sec., and injects the entire vehicle into orbit.
- **T plus 2,415 sec.**—Able Star burning is cut off for the second time. The vehicle will be spun at a rate between 2 rpm. and 15 rpm. This rate is expected to be maintained during the satellite's life.

At this phase of the trajectory the Able Star vehicle should be in a 650-naut. mi. circular orbit with approximately a 28-deg. inclination. The launch will be considered a success if an elliptical orbit is achieved with an apogee under 1,000 naut. mi. and a perigee exceeding 500 naut. mi.

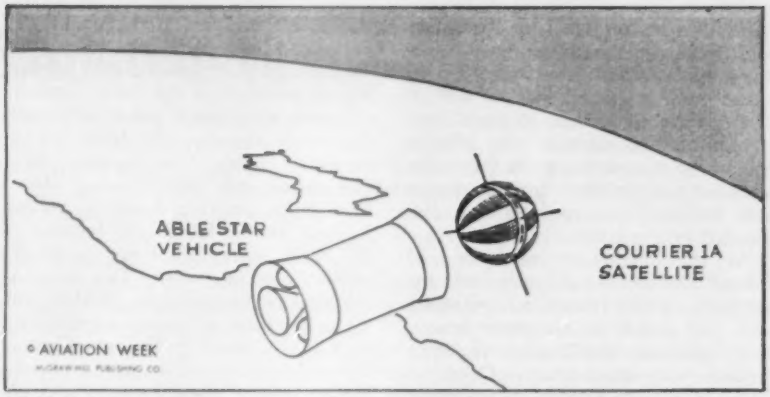
- **T plus 2,433 sec.**—Courier IA payload separates from Able Star vehicle after explosive bolts are blown.

Operational Details

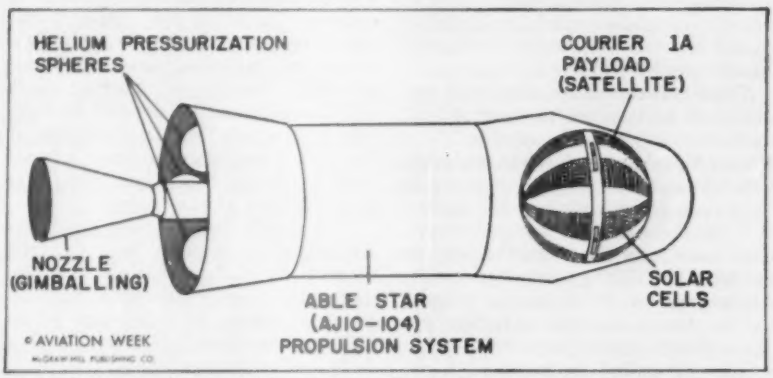
Courier IA communications satellite operates in a dual role. It will receive messages from the ground, retain them in storage units, then rebroadcast these messages to other ground stations as commanded. In addition to this delayed-repeater mode, the satellite will incorporate real-time test capability, so that by command the storage capability may be shunted to allow the satellite to receive and transmit information in real-time manner, without delay.

Internal environment of the satellite and various trajectory data will be transmitted on an FM/FM telemetry channel.

As Courier IA orbits the earth it will



COURIER IA will separate from Able Star vehicle and be injected into orbit just before passing over the southeast coast of Africa at an altitude of about 650 naut. mi.



ABLE STAR second-stage vehicle will house Courier IA in its nose. Large sphere, about 50 in. in diameter and weighing about 475 lb., will almost completely fill the nose cone. Solar cells will be patterned in triangular segments on the payload's surface.

Courier Vehicle

Courier IA satellite boost vehicle will be the Thor-Able Star, composed of a first stage Thor using RJ-1 and liquid oxygen for propellant, topped by a second stage AJ-10-104 Able Star using a hypergolic combination of inhibited red fuming nitric acid and unsymmetrical dimethyl hydrazine, with a specific impulse of 275-280 lb.-sec., and developing a thrust of 7,750-7,850 lb.

The Able Star vehicle is about 19 ft. over-all, including propulsion section about 10 ft. long, and nose section about 9½ ft. long, housing the payload. Vehicle diameter is about 4½ ft.

Thrust chamber is regeneratively cooled, the nozzle is gimbaled and the fuel system is helium-pressurized.

Engine has shutdown and restart capability, actuated by ground command signals in conjunction with programmer in the vehicle.

Courier IA

Sponsored by Advanced Research Projects Agency, Courier is being managed by Army Signal Research and Development Laboratories with Philco Corp. responsible for the payload, International Telephone & Telegraph Laboratories for ground-based communications, and Radiation, Inc., for ground antennas. Air Force Ballistic Missile Division's Thor-Able Star boost vehicle will put the payload into orbit, and Space Technology Laboratories is responsible for systems engineering and technical direction of the boost vehicle, including automatic guidance for the Able Star stage.

transmit a beacon signal for acquisition and tracking by ground stations. When the satellite comes within range, a command from a ground station will activate the microwave receivers and transmitters to operate the storage equipment for receiving messages for resending to another ground station after the satellite is acquired and commanded by the latter.

As the microwave receivers and transmitters are initially activated, the satellite's VHF transmitter automatically will switch its low-power beacon to a high-power condition on the same frequency for transmission of data relating to satellite internal environment.

The satellite will be acquired by a ground station through a mechanism consisting of a clock and tape which will give a coded signal, changed at regular intervals to introduce new command control.

A substantial number of ground stations will be involved in tracking and communicating with the satellite:

• **Army Signal Research & Development** Laboratories-International Telephone & Telegraph Laboratories' main station at Cape Canaveral will forward countdown data to all the ground stations in the ASRDL-ITTL network. Early orbiting data also will be transmitted to these various stations in order to initiate the communication experiment.

• **Space navigation center** (SPAN), operated by personnel from Air Force's Ballistic Missile Division and Space Technology Laboratories, will obtain launch information via Cape Canaveral's radar installation, which will track the missile initially, plus telemetry information during Thor burning phase and initial Able Star burning phase. Downrange tracking facilities in the Atlantic Missile Range will forward to SPAN the trajectory information as the satellite goes into orbit. This information will be forwarded to ASRDL and the space tracking facility operated by Air Force's Cambridge Research Center. This information will be used for tracking by both of these facilities and for computation by ARCRC to predict forthcoming orbital conditions.

• **Mobile tracking van** operated by STL personnel in Africa will obtain telemetry information from the Able Star vehicle to determine initial conditions of orbit. This doppler tracking effort will complement the doppler tracking data obtained by Minitrack stations of National Acronautics and Space Administration during Thor and Able Star powered flight phases.

The mobile tracking van, reportedly the largest in existence, was designed by STL for Ballistic Missile Division, under direction of Advanced Research Projects Agency. It is manned by an STL six-man crew and is fitted with a 28-ft. radio-telescope.

House-Senate Conferees Agree On Increased Defense Budget

Washington—House-Senate conferees agreed last week to substantial increases in the $39.3 billion Fiscal 1961 defense budget proposed by the Administration.

The conferees approved a total of $39.9 billion, including $1.2 billion for Department of Defense; $17.1 billion for Air Force; $12.1 billion for Navy, and $9.5 billion for Army.

These are the major actions taken by the conferees:

• **B-70.** The $265 million approved was $190 million more than the Administration request and is to provide for development of the Mach 3 bomber as a full weapon system. The $75 million asked by the Administration provided for a research program involving two prototypes. In addition, the conferees provided that $100 million approved for Convair F-106 interceptor could be used on North American B-70 program.

• **F-106 interceptor.** House voted $215 million for 50 interceptors as a substitute for Bomarc B missiles. This was not requested by the Administration, and was eliminated by the Senate after USAF testified against the House proposal. Conferees agreed on $100 million for F-106s, but allowed USAF to shift the money to the B-70 program.

• **Bomarc B.** The $244 million approved by the conferees for procurement of the air defense missile was $50 million below USAF's request. The House had previously eliminated all funds for operational Bomarcs, allowing only $50 million for development testing "if this is considered necessary."

• **Airborne alert.** The $170 million agreed to by the conferees was double the $85 million requested by the Administration. Gen. Thomas S. Power, commander of Strategic Air Command, recommended $570 million to develop an airborne alert capability for one-fourth the SAC B-52 fleet, instead of the program for one-eighth of the B-52 force provided for in the Administration request.

• **Aircraft carrier.** The full $293 million asked by Navy for a new conventionally-powered carrier was approved. House conferees, who for years have successfully opposed funds for carriers, retreated from House cancellation of the program this year.

• **MATS modernization.** Conferees voted $200 million for procurement of an interim modernization plane—the Lockheed C-130B with extended range, the cargo version of the Boeing KC-135 tanker, or a similar type. This compared with $250 million voted originally by the House and urged by the Army. After the House action, the Administration agreed to $150 million for modernization of MATS. In addition to the $200 million, the budget provides $50 million proposed by the Administration for development of an advanced cargo type for MATS.

• **Satellites.** The conferees added $145 million to the budget for use on Samos reconnaissance satellite, Midas missile warning satellite and Discoverer experimental satellite programs.

• **Polaris program.** Both House and Senate added $241 million to the Administration request of $1.1 billion for the fleet ballistic missile program to provide for full-funding of five submarines and partial funding of seven, so this was not an issue with the conferees. The Administration request would fully finance three submarines and partially finance nine.

• **Contract waste.** A flat 3% across-the-board cut in all procurement categories voted by the House to force the elimination of alleged waste and excessive costs and profits on defense contracts was sustained by the conferees. After vigorous opposition from Defense Department and each of the services, the Senate had eliminated the provision.

New Hercules Policy

Washington—Defense Department has canceled plans to install Nike Hercules at Strategic Air Command bases and has shifted air defense priority to coastal and northern metropolitan areas.

New policy will place Hercules around seven large cities instead of at six SAC bases formerly scheduled. Hercules sites at another SAC base and an atomic plant will be dismantled.

Fifteen existing Nike Ajax batteries will be modified for Hercules in Washington-Baltimore, New York, Los Angeles, Philadelphia, Detroit, Chicago and San Francisco areas.

Defense Department says the policy change results from recent reduction in air defense forces, existence of adequate early warning for bombers, and hardened underground silo installations for missile bases involved in the cancellation.

Hercules sites have been canceled at four SAC bases and two SAC tenant bases.

Existing Hercules defenses will be removed from Hanford, Wash., site of an atomic plant, and Rapid City AFB, S. D., a Titan base.

Senate Boosts Construction Appropriation

By Ford Eastman

Washington—Senate approved a $1 billion Fiscal 1961 military construction budget last week which places increased emphasis on facilities for aviation, missile and space programs.

The construction budget approved by the Senate was nearly $121 million below the Administration's original budget requests, but more than $191 million higher than the appropriation passed by the House earlier.

Senate approved a budget with these changes:

• **Air Force**—$656.4 million, an increase of $137.7 million over the amount allowed by the House, but $26.4 million decrease from Administration requests.

• **Army**—$169.8 million, an increase of $22.7 million over the House-approved bill but a decrease of $41.1 million from budget estimates.

• **Navy**—$166.6 million, an increase of $10.1 million over the figure approved by the House, but $26.4 million under budget estimates.

• **Army Reserve**—$16.038 million, an increase of $4.038 million over budget estimates and the amount approved by the House. Navy and USAF reserve budgets of $4 million were approved by the Senate and House.

• **Air National Guard**—$13.8 million, an increase of $6.8 million over the budget estimate and the amount the House approved. Army National Guard appropriation was $17.5 million, an increase of $9.5 million over the budget estimates and House bill.

Sen. John Stennis (D.-Miss.), Military Construction Appropriations Subcommittee chairman, said the estimates were cut to a point where the bill represents "bone and muscle" but includes items which the committee felt were essential to the support of military programs. Senate took the following action:

• **Added $90 million** to advance the financing of the 11th and 12th Titan intercontinental ballistic missile squadrons, which Stennis said would permit better phasing between construction of the bases, installation and checkout of ground support equipment and missiles so that the operational dates of the Titan will be achieved.

• **Authorized the transfer** of up to $20 million from pay and allowances to the Advanced Research Projects Agency to be used for construction.

• **Restored 34 maintenance docks** at various air bases in the U. S. in direct support of the Strategic Air Command's dispersal program.

• **Added funds for construction** of operational and maintenance facilities for Army aircraft with field forces and for training of Army aviation personnel. Sen. Stennis said this was done in recognition of the Army's expanding mission in the missile field, which requires earlier and more precise methods of target identification.

• **Authorized $17 million** for construction of the Samos and Midas.

• **Restored numerous research** and test laboratories deleted by the House which Sen. Stennis said were necessary for basic and applied research if the U. S. is to continue its progress in the space and atomic age.

• **Provided additional funds** to permit the Air National Guard to expand its operational bases in order to assume part of the Army defense mission. This includes funds to make the ANG's fields capable of handling Century-series aircraft.

• **Provided "essential"** support facilities for the construction, overhaul and operation of nuclear powered and fleet ballistic missile submarines; for submarine and anti-submarine warfare forces in the area of research, training and readiness operations; for berthing space for aircraft carriers; for more effective use of research and development facilities as related to new weapon systems, and for construction of facilities to support Polaris, Pacific Missile Range programs.

The Senate agreed with the House in denying all requests for commissaries requested by the services and for overseas housing, community support facilities.

On the Air Force military construction budget requests, the Senate:

• **Concurred with House** action in approving $13,821,000 for the Alaskan Air Command, the amount requested in the revised budget request.

• **Approved $24,763,000** for the Air Defense Command, an increase of $3,027,000 over the amount approved by the House, but still $4,395,000 under budget estimates.

• **Approved $16,325,000** for the Air Materiel Command, $8,285,000 more than the House approved. Among items restored were an electronics laboratory at Kelly AFB, laboratories at Stockbridge Annex, N. Y., and Wright-Patterson AFB, and maintenance docks at Robins and Wright-Patterson AFBs.

• **Approved $23,741,000** for the Air Research and Development Command, an increase of $3,143,000 over the House allowance. Restorations include an electronics laboratory and division headquarters at Hanscom AFB and a nuclear laboratory at Kirtland AFB.

• **Approved $28,225,000** for the Air Training Command, an increase of $7,589,000 over the House allowance.

• **Approved $5,249,000** for the Military Air Transport Service, $3,200,000 more than the House allowed, for expansion of the plant at the Aeronautical Chart Center.

• **Approved $52,528,000** for the Strategic Air Command, an increase of $12,672,000 over the amount approved by the House, but $16,853,000 below budget estimates. Restorations included maintenance docks, an addition to SAC headquarters at Offutt AFB, operation apron at Francis E. Warren AFB.

• **Reduced Tactical Air Command** appropriations to $8,101,000, which is $176,000 below the House figure and $724,000 below budget estimates.

• **Approved $24,302,000** for the aircraft control and warning system, an increase of $459,000 over the House, but $10,500,000 below budget estimates.

• **Concurred with the House** in providing $300 million for ballistic missile facilities construction.

In the Army and Navy construction budgets, the Senate:

• **Approved the House cut** of $7,171,000 for the Signal Corps Research and Development Laboratory at Fort Monmouth, N. J., but restored $550,000 for a climatic test chamber research and development facility.

• **Approved House action** in providing $2,031,000 to the Defense Atomic Support Agency for construction of a medical research laboratory at the Naval Medical Center, Bethesda, Md., and two minor projects at Sandia Base, N. M.

• **Approved a House cut** of $1,354,000 from the $10,534,000 requested for the alternate joint communications center, and then cut another $3,783,000 from the requests to reduce the appropriations to $5,217,000.

• **Concurred with House** action in approving the full amount of $42,598,000 requested for surface-to-air missile tactical facilities to provide for improvements to Nike Hercules facilities.

• **Deleted $1,334,000** for an inertical guidance test facility at Johnsville, Pa. and said it agreed with the House that "there is probability of duplication of effort within the military departments in this area of test and evalution."

Winter Study Report

Bedford, Mass.—Long-awaited report by Air Force's Winter Study Group on possible amalgamation and/or redirection of USAF's many large electronic support systems (AW June 6, p. 30) was presented to scientific advisory group, headed by Dr. Albert G. Hill, late last week. Similar briefing is slated to be given to user commands within the next 10 days. Following this, Air Force is expected to present a briefing to industry.

President Blamed for Loss of U-2 Program

By Katherine Johnsen

Washington—"Bumbling and fumbling"—beginning with the launching of a Lockheed U-2 espionage flight over the Soviet Russia on the eve of the summit conference and ending with the "self-righteous" assumption of responsibility by the President—have absolutely ruled out any resumption of the highly successful aerial reconnaissance program, Sen. William Fulbright (D.-Ark.) told the Senate last week.

Fulbright, chairman of the Senate Foreign Relations Committee, presented the Senate with a 30-page report on testimony taken by his committee from top government officials on events related to the summit conference (AW June 6, p. 19).

The committee report, extensively compromised to assure bi-partisan support, is an analysis of the testimony which does not draw clear cut conclusions or make recommendations. It was approved by a 14 to 1 vote. Sen. Homer Capehart (R.-Ind.) voted against it "because I do not think it promotes the best interests of the U.S. and international relations." Sen. Alexander Wiley (R.-Wis.) and Sen. Frank Lausche (D.-Ohio) abstained. Fulbright's speech, which was worded much more strongly than the written report, was based on the factual information presented in the report.

"Short of the madness of preventive war, I can think of nothing more dangerous than to resume overflights of the Soviet Union," Fulbright said. "These overflights were useful while they lasted, but they have now obviously become, as the professionals describe it, compromised."

Those who now deplore the cancellation of these flights can lay direct blame on the assumption of responsibility by the President, according to Fulbright. "It is unprecedented among civilized nations for a chief of state to assume personal responsibility for covert intelligence operations. . . . One reason intelligence agencies exist is to serve as a whipping boy in cases of this kind," he said.

In this system of diplomatic forms, Fulbright reasoned, "the chief of state embodies in his person the sovereignty and dignity of his country. It is totally unacceptable for one chief of state because of this personal embodiment to impinge upon the sovereignty of another, and much less so for him to assert the right to do so. . . . It is quite unacceptable to any state to be in the position in which this government put the Soviet Union last month.

"Although another man would have most likely been more temperate in his choice of language, it is difficult to see how anyone could have been expected to act substantially different from the way Chairman [Nikita] Khrushchev acted under the circumstances which confronted him in Paris."

If a Russian counterpart of the U-2 had been downed over Kansas, Fulbright said, the incident "would have brought speeches in the Senate powerful enough to rock the Capitol dome with denunciations of the perfidy of the Soviets on the eve of the summit conference and with demands that the President not go to Paris. But then, reflect how much more violent the reaction here would have been if Mr. Khrushchev had said he was personally responsible for the flight and at the same time left the impression that he had every intention of trying it again."

Commenting that "it was bad enough" for President Eisenhower to assume responsibility, Fulbright added that "it was worse for us then to leave the impression that the flights were to be continued, and even more, to go to such lengths to justify the flights."

The need for information gives a justification for intelligence activities which any government can understand, Fulbright said. "But it becomes quite intolerable to go beyond this and attempt to make it appear that the flights were really the Soviets' own fault; that if the Soviets had not been so secretive, we would not have had to spy on them."

He pointed to the difference between saying "we tried to get intelligence, because we ne ded it," and saying "we needed intelligence and this gave us the 'right' to try to get it."

Fulbright said the argument that the President "should tell the truth" is "irrelevant." He commented that the President should be commended "for following the rigorous standards of honesty set by young George Washington. But, although Washington admitted chopping down the cherry tree, he did not go on to say, 'Yes, I did it, and I'm glad. The cherry tree was offensive to me, because it had grown so tall. I needed some cherries, and I shall chop down other cherry trees whenever I want more cherries.'"

Although the technical skill demonstrated by almost four years of U-2 flights aroused "widespread admiration," Fulbright said, the "unfortunate series of blunders" in dealing with the capture of the U-2 has resulted in a worldwide loss of confidence. He anticipated that this would lead to neutralism among U.S. allies. As indications, Fulbright pointed to the contributing factor of neutralism in Japanese riots against the U. S.-Japanese defense treaty, and the groundswell of sentiment in Mexico against establishment of a U. S. missile-tracking site on Mexican territory.

Fulbright questioned that the information sought on the May 1 flight "was in fact as important as it has been represented. There is ground here for the conclusion that the alleged extraordinary importance of this information is the Administration's cover story for its own costly mistake."

It is understood that the primary reconnaissance objective of the flight was information on the expected launching of a manned satellite on the Communist national holiday. Russia did launch the Sputnik IV dummy-in-space ship on May 15 (AW May 23, p. 27).

The Foreign Relations Committee report doubted that the flight was worth the price risked, but did not pass judgment since witnesses had refused to give information on its objective, even on a classified basis. The report did highlight the fact that no top policy level authorization was given for the specific flight.

One committee member, Sen. Mike

Aerospace Corp. Aims

Aerospace Corp., a nonprofit organization formed to serve Air Force scientific planning and management of missile and space programs, will aim to accelerate programs in such areas as advanced reentry vehicles—including penetration aids—in new propulsion and guidance systems, satellite communications systems, satellite inspection systems, manned military space systems and other corollary undertakings (AW June 27, p. 25; AW June 20, p. 82).

Aerospace Corp. will recruit talent from available sources from around the country to fill a variety of positions in connection with its new responsibilities in such programs as Samos, Midas, Discoverer and other military space systems in an earlier stage of development. Company may be called upon to accept contracts from government agencies other than the Air Force.

It will utilize extensive laboratory and other facilities at the El Segundo, Calif., research and development center which the Air Force is purchasing from Space Technology Laboratories. These facilities initially will be shared by Aerospace, ARDC's Ballistic Missile Division, AMC's Ballistic Missile Center and units of Space Technology Laboratories serving Air Force programs.

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U-2 WING leaning against the trees in a forest near Sverdlovsk, USSR, is inspected by a Soviet officer (left of wing). Damage to the wing was slight considering the unusually light construction of U-2 aircraft. Right wing which is shown above was sheared off the fuselage, and the trailing edge was torn away. Slipper fuel tank on the wing leading edge received most of its damage on the bottom. Inset (above right) shows stencil carried on U-2 just below pilot's cockpit. It calls for the use of a specially refined low-volatility kerosene purchased in small quantities by the Air Force.

Mansfield (D.-Mont.), said that control and timing of the U-2 flight was "in the hands of various obscure employes of the bureaucracy." The report gave these details on the operation of the U-2 program:

• **Central Intelligence Agency** operated, but did not give "top direction" to the flight program. This came from "a small and informal group consisting of representatives from the Department of State, Department of Defense, and the White House. Knowledge of the project was restricted to as few people as possible, and communication about it within the government was by word of mouth to the greatest extent possible."

• **Defense Department** gave "technical advice" to CIA. "Flights were planned according to priorities assigned [to] particular aspects of intelligence, and programs involving one or more missions were authorized from time to time. Each program included a number of alternatives, with the final selection to be made by CIA on the basis of such contingent factors as the weather and aircraft and pilot readiness. It was customary for CIA to consult with the informal group . . . after each flight and before mounting another one."

• **Policy officials maintained** only casual contact with U-2 operations. Over a period of almost four years the flights had become "routine." "Although the President, the Vice President . . . and the appropriate cabinet officers were knowledgeable of programs of flights, they were not knowledgeable of individual flights in advance, nor did they specifically approve the timing of individual flights beyond a general approval within a given time span."

• **Order for the May 1 flight** was sent from Washington in the late afternoon of Saturday, Apr. 30. "It is not clear when the program, of which the flight was a part, was authorized . . . the memories of executive branch officials were vague." Secretary of Defense Thomas S. Gates, Jr., said that it was "some weeks before May 1," that he approved the program including the May 1, flight. Secretary of State Christian Herter approved the program "some time prior to the time I went abroad"—which was on Apr. 26.

The hope of U.S. officials seeking means to penetrate the iron curtain in 1954 was a plane that could escape radar detection. The committee said that this hope "was not fully realized" with the U-2 but that "on other counts the performance of the U-2 and its camera, which were operational by mid-1956, exceeded expectations."

The committee termed the program "one of the history's most dramatic and successful intelligence operations," and said that prior to May 1, there had been "no losses over Soviet territory," although the Soviets had knowledge of the flights through radar trackings and otherwise.

All officials involved agreed that the flights were of "great value" to the U.S., the report said, providing information on, among other things, Soviet airfields, aircraft, missiles, missile testing and training, special weapons storage, submarine production, atomic production, and aircraft deployments.

In his Bucharest speech to the Ru-

USAF Defers Slam Airframe Selection

Washington—Selection of the airframe contractor of Project Slam's nuclear ramjet-powered, supersonic, low-altitude missile will not be made until next year, according to present Air Force projections. Choice in the keen competition between the three contenders—Chance Vought, Convair and North American Aviation—will be deferred until after the Tory II-A reactor is demonstrated late this year at Atomic Energy Commission's Jackass Flats, Nev., site (AW June 20, p. 206) which will afford a test-stand preview of some of the technical problems expected to be encountered in any advanced experiment such as Tory. Tory II-A is the reactor feasibility program for Project Pluto's nuclear ramjet development for the Slam missile.

With propulsion development for Slam thus going ahead and integration of this development into the weapon system being delayed because of the deferment of airframe contractor selection, an additional factor is being introduced which may reorient efforts and divide responsibility for execution of the propulsion-package program. A strong bid is being made by Westinghouse Electric Corp.'s Astronuclear Laboratory, Pittsburgh, Pa., for the reactor portion of the Pluto program, possibly as a teammate of Marquardt Corp., Van Nuys, Calif., which so far has had Air Force nuclear propulsion responsibility for the Pluto nuclear ramjet development. Westinghouse's effort to establish a position in high-temperature reactors is reported to have support at top levels of the Atomic Energy Commission and the Air Force.

The joint Air Force-AEC office at Germantown, Md., has cognizance of the Pluto program, and is commanded by Brig. Gen. Irving Branch. Decision on whether Westinghouse will be funneled into the program and, if it is, the extent of its responsibility in the reactor portion of the Pluto nuclear ramjet development, is expected to be made shortly. Specific details on how Westinghouse would participate in the program have not yet been completed.

The entry of Westinghouse as a possible contender in the Pluto program has introduced considerable conjecture among industry observers. General Electric Co. also has loomed large as likely competition, but its participation in immediate-future military nuclear projects is conjectural. The Air Force's nuclear turbojet program now is being re-evaluated by a review committee. Indications are that the General Electric program, which had been supported with approximately $100 million a year and which recently had been decreased, may be further de-emphasized and possibly eliminated, with emphasis shifted to support of Pratt & Whitney Aircraft's work in the nuclear turbojet field.

Marquardt has been working on the nuclear ramjet in conjunction with AEC's Lawrence Radiation Laboratory, operated by University of California at Livermore, Calif. LRL's participation has been oriented strongly to emphasize research, a vital factor in the early phase of the Pluto program, but the question of who is going to conduct the engineering phases of the nuclear portion of the Pluto program as it advances is high lighted by the timing of Westinghouse's effort.

Westinghouse's Astronuclear Laboratory, which was set up about a year ago, has participated in proposals for nuclear-powered auxiliary power systems for space applications and is aware of the opportunity the Pluto development program offers. Westinghouse's general experience, such as in the Navy's nuclear submarine program and in the commercial nuclear reactor power source field, gives it a substantial position in its bid for participation in the reactor portion of the Pluto program.

manian Workers Party Congress, Premier Nikita Khrushchev took issue with this evaluation (AW June 27, p. 35). "I assert that the data obtained by the spy flights are of no importance to the defense of the U.S.," he said. "We know that the spy flights were carried out over regions which have no rocket bases.

"We know that two or three years ago regions where experimental rocket-launching sites were situated were photographed. Only the experimental ground for launching rockets were photographed, not the rocket bases of military and strategic importance . . .

"But suppose rocket bases were photographed. What importance can this have for the defense of the country or for averting a sudden attack? None whatsoever. Information on the location of bases is important, not for the state concerned with its defense, but only for the state which intends aggression and whose aim is to strike the first blow; to avoid retaliation it must first destroy rocket bases.

"It is true that, given modern means, it is impossible to put a rocket base out of commission by one, two, or even several attacks. Rocket technology ensures a counterattack in every instance."

The committee report said that Khrushchev's statements that the U-2 piloted by Francis Powers was brought down from its normal altitude of 60,000 ft. with a single rocket "can well be discounted." But it added that "the fact remains that we do not really know how the U-2 was brought down. It is entirely possible that the Russian capability in this field is somewhat greater than had been thought, and that it has improved since the U-2 flights were begun in 1956."

The committee said it was assured by secret testimony that there is "no reason to believe that technical preparations for the flight were faulty or that the pilot was unreliable in any respect."

The report said the release of information on the U-2 flight lacked "direction" throughout, from release of a long-prepared and vague "cover" story after CIA had informed State Department around noon on Sunday, May 1, that the flight was overdue; to a more detailed "cover" story released by State Department at 12:45 p.m. on May 5; to the still more detailed "cover" released by National Aeronautics and Space Administration 45 min. later; to the May 6 noontime statement by Lincoln White, State Department public affairs officer, that "there was absolutely no deliberate attempt to violate Soviet airspace and there has never been"; to the May 7 "part cover" statement of State Department that "a flight over Soviet territory was probably undertaken" and that "the necessity for such activities as measures for legitimate national defense is enhanced by the excessive secrecy practiced by the Soviet Union"; to the May 9 State Department statement forcefully denouncing Soviet secrecy and announcing that the President "has put into effect since the beginning of his Administration directives to gather by every possible means the information required to protect the U. S. . . ."; to the delay until May 16 of the President's clarification in Paris that the U. S. definitely would discontinue the flights.

The committee noted that on May 5 the State Department received a wire from the U. S. Embassy in Moscow stating that other diplomats reported that the U-2 was down and that the Soviet government had the pilot. On the "important point" as to whether the telegram was received in the morning before the State and NASA detailed "cover" stories were released, or in the afternoon, the testimony is conflicting, the committee said. Under Secretary of State Douglas Dillon testified it was in the afternoon. "Elsewhere in the published record," the committee said it was indicated that the information was available in the morning.

Although it was not known in Washington until May 7, as to where the U-2 had been downed, the report pointed out that the plane's flight plan was known "and it would have been a reasonable assumption that the chances were quite good that the plane was nowhere near the Soviet border"—as indicated in the May 5 statements of NASA and State Department.

NASA Reorients Delta Launch Schedule

By Evert Clark

Washington—Delta space vehicle program will be limited to a total of 12 launchings and the firing schedule has been altered to eliminate five attempts to put satellites into polar orbits from the Pacific Missile Range.

The 11 remaining shots will be fired from Cape Canaveral, Fla., over the Atlantic Missile Range. Most Delta experiments can be fired into non-polar orbits without appreciable loss in scientific value, and the few that cannot will be shifted to the Thor-Agena B vehicle and launched from the West Coast facility, National Aeronautics and Space Administration told AVIATION WEEK.

Delta was conceived as an interim program shortly after NASA was created (AW Nov. 9, p. 27). It was to use proven existing hardware—the Douglas Thor missile booster, the Aerojet Vanguard second stage engine, the Hercules-Allegany Ballistic Laboratories third stage engine from Thor-Able vehicles, and the Bell Telephone Laboratories radio command-inertial guidance system.

Although NASA ordered only 12 vehicles originally, it expected that there would be reorders and that the Delta program would run for several years. The first six or seven shots were to be fired from Cape Canaveral. The Delta operation then was to shift to the West Coast and stay there.

At that time, however, the Thor-Agena B had not been planned by USAF. Just as initiation of development of the restartable Agena B stage resulted in the cancellation of NASA's Vega vehicle (AW June 27, p. 62), its expected availability for use by NASA on the Thor booster about the end of 1961 has resulted in the Delta changes.

Increased Reliability

Thor-Agena B will be "exercised," or used extensively by USAF. This dual use by the military and a civilian agency will increase the number of firings well above what would be achieved with the Delta by NASA alone, and therefore will increase the chance of reliability, NASA believes. It also carries a heavier payload than Delta.

Thor-Agena B is expected to be ready for NASA's use late in 1961. The original Delta schedule called for the last of 12 shots to be fired in March, 1962. Launching dates under the revised Delta schedule have not been revealed. Although the first of the 12 shots was fired about two months late and the second shot is past schedule, NASA said it hopes to complete the Delta series approximately on the original timetable.

Since there will be no long follow-on program of Delta firings from the West Coast, NASA decided it did not make sense to uproot the ground support equipment and the Delta personnel and move them to the Pacific Missile Range for the last five shots. The move would have been costly in money, time and possibly in reliability.

No Delta shots from Florida will attempt to "dogleg" into polar orbits. One of the 12 Deltas, carrying an Echo inflatable passive satellite, has been fired so far. It failed to go into orbit last May 13 when attitude control jets in the second stage failed to operate (AW May 23, p. 60).

The three remaining Echo spheres can be launched into non-polar orbits without any great loss in value, NASA says, because they are primarily research and development shots. If the passive communication satellite becomes operational later and a polar orbit is required, launchings will be made from PMR using some other vehicle.

Another factor in the change is that at least two Delta experiments seemed to be worth scheduling for two launchings each. If all four shots are successful, the experiments are worth repeating anyway. If some shots fail, each experiment still will have had two chances to succeed.

Duplicate Experiments

These are the S-3 radiation belt variation experiment, originally scheduled for next October, and the S-16 solar spectroscopy experiment, originally scheduled for next December. The S-3 satellite is to be an 82-lb. payload aimed at a highly elliptical orbit with a 150 naut. mi. perigee and 40,000 naut. mi. apogee. The S-16 is to be a 300-lb. payload aimed at a 400 naut. mi. circular orbit, to measure lyman-alpha radiation in an attempt to help understand processes involved in the generation of solar energy.

The S-6 atmospheric structure experiment, originally due for launching into a polar orbit in July, 1961, can be switched to AMR without losing its value also, NASA said. The same is true for the P-14 lunar probe, originally scheduled for last month, and the Tiros-II originally scheduled for next month.

Two former Delta payloads will be shifted to Thor-Agena Bs because polar orbits are mandatory—the S-26 flashing light geodetic satellite and the S-27 "topside sounder" satellite, a 200-lb. payload being developed by Canadian scientists for a joint U.S.-Canadian probing of the ionosphere. Under the old Delta schedule, S-26 was to be launched in September of next year and S-27 in November of next year.

Combining of the geodetic payload and the topside sounder into the same launching has been discussed, but it may not be done because the lead time necessary for the three military services and NASA to set up a ground network for the geodetic satellite would delay launching of the ionospheric experiment.

Other Payloads

All Thor-Agenas used by NASA will be B models and will be launched from PMR under present plans. This simplifies ground support equipment problems. Other payloads planned for launching by these vehicles are:

- **Nimbus** earth-oriented meteorological satellite, which will follow the Tiros series.
- **Geophysical observatory** in a nearly circular earth orbit.
- **Geophysical observatory** in a highly elliptical orbit.

No payloads have been created specifically because the Thor-Agena is replacing Delta for the polar shots. Some of the payloads to be carried by the Thor-boosted vehicle had been planned for later Vegas before that program was killed.

No NASA payloads now scheduled for Thor-Agena flights will depend on use of the SNAP nuclear auxiliary power systems. SNAP units are not expected to be ready for civilian space use for several years (see p. 61).

NASA believes that the principle of launching two or more satellites with the same vehicle (AW June 27, p. 60) is "entirely feasible and quite desirable," one official said. But right now the agency prefers a different approach —standardization of satellite and space probe "shells" and use of a single, central power column and telemetry.

A great variety of types of experiments could be carried without the necessity of developing a new shell and communications system each time a new satellite was planned. This approach is being tried to some degree in the geophysical observatories and the orbiting astronomical observatories. These would be true "spacecraft," a word NASA prefers to payload for the more sophisticated satellites. Eventually, NASA would like to go to a plug-in concept for as many experiments as possible.

Defense Changes Security Rules, Reduces Classification Coverage

Washington—Defense Department has adopted new industrial security rules which industry expects to be a substantial improvement in dealing with problems brought about by over-classification of military projects.

The revision calls for classification of sensitive information rather than of hardware or documents. Defense Department says there will be a substantial reduction in quantities and types of items which must be safeguarded. Changes were supported by industry groups.

Under previous plant security requirements, a system containing a sensitive element was considered a classified project, and the contractor was required to apply security measures not only to data on the sensitive system but also to the system itself and all related components. With a sizable system, compliance could have required guards, fences, clearances for employes and the use of registered mail and shipments.

Defense said the revision divorces classification from media (hardware or documents) and applies it to specific characteristics, such as performance and production rate.

An estimated 24,000 U.S. companies are cleared to work on classified military contracts, with a million employes holding security clearances.

Association Review

The revision is incorporated in Appendix I to the Industrial Security Manual and in a new security requirements check list (DD Form 254). It was developed by the Navy. Four industrial associations were asked last fall to review and comment on the changes. Member firms of Aerospace Industries Assn., American Society for Industrial Security, Electronic Industries Assn., and National Security Industrial Assn. were canvassed, and they supported the changes.

The new security checklist specifies that publicity releases be submitted to the Defense Department for security review. The previous form did not contain this requirement, although the Industrial Security Manual gives clearance prerogative to Defense. New rules will eliminate the possibility of further classification of an end-product if the product in itself does not reveal classified performance characteristics or specifications.

Defense project monitors now are required to explain to contractors why an item is classified. Previously, contractors were told only what was classified, with no explanation.

Another feature of the revision is a mandatory annual review by the Defense Department of classified items in each contract, with heavier reliance in the judgment of defense representatives in the field.

New regulations apply to contracts issued after June 15. Contractors have the option of applying the amendments to previous contracts "if they have the manpower to do it," Defense said.

The revised DD Form 254 check list assigns classifications to two broad categories—performance characteristics and test data and design, and end items. Individual items are checked top secret, secret, confidential, confidential (modified handling) and unclassified. Modified handling category requires less secure handling than confidential.

The first category includes accuracy, altitude, counter-countermeasures capability, depth, design information, formula or material, fuel/propellant, lethality/critical effects, maneuverability, alert time/time cycle, orbit/trajectory, range, reliability, resolution, signature characteristics, speed/velocity, system capacity, terminal ballistic, thrust and vulnerability. End item classifications are external view, military application, numbers contracted, program and production schedules, delivery rate, numbers delivered, degree of protection in transit and unit cost.

Eliminated from the old form, in use four years, are classifications for contract elements, drawings and photographs, models, mockups, and training aids, all of which presumably will be unclassified if they themselves do not reveal sensitive information.

Data Systems Unit Established by AMC

Washington—Air Materiel Command has established a directorate of data systems to centralize functional control of stock items used in aircraft, missile and spacecraft logistic support.

Gen. Samuel E. Anderson, AMC commander, told the Aero Club of Washington last week that his command is placing heavy emphasis on electronic processing so that data on future requirements as well as current stock levels will be available at all times.

Philosophy of "dynamic readiness," Anderson said, requires fast logistic reaction which begins when a weapon system reaches the active inventory and lasts until the system is phased out. To fill this requirement, AMC has instituted a series of new operational techniques along with three major changes in supply methods:

- **Commodity management,** which is integration of complete systems at central supply "supermarkets." Previously, replacement of high priority components in a single system could have required orders to a number of depots.
- **Selective item management** in which high usage parts are identified and segregated. The Republic F-105 system, for example, contains 60,000 replacement items, only a small percentage of which will be selected for high priority treatment.
- **Direct support,** by moving items from supply sources to the user without diversionary stops at intermediate supply depots. Direct support already has permitted USAF to phase out overseas logistics facilities, as well as many in the U.S.

In addition to electronic processing, Anderson said, AMC is continually improving operational techniques by faster deliveries, using contract and MATS airlift for all premium shipments; advanced packaging, on which USAF spent $750 million last year to assure survival of materials, and automated materials handling.

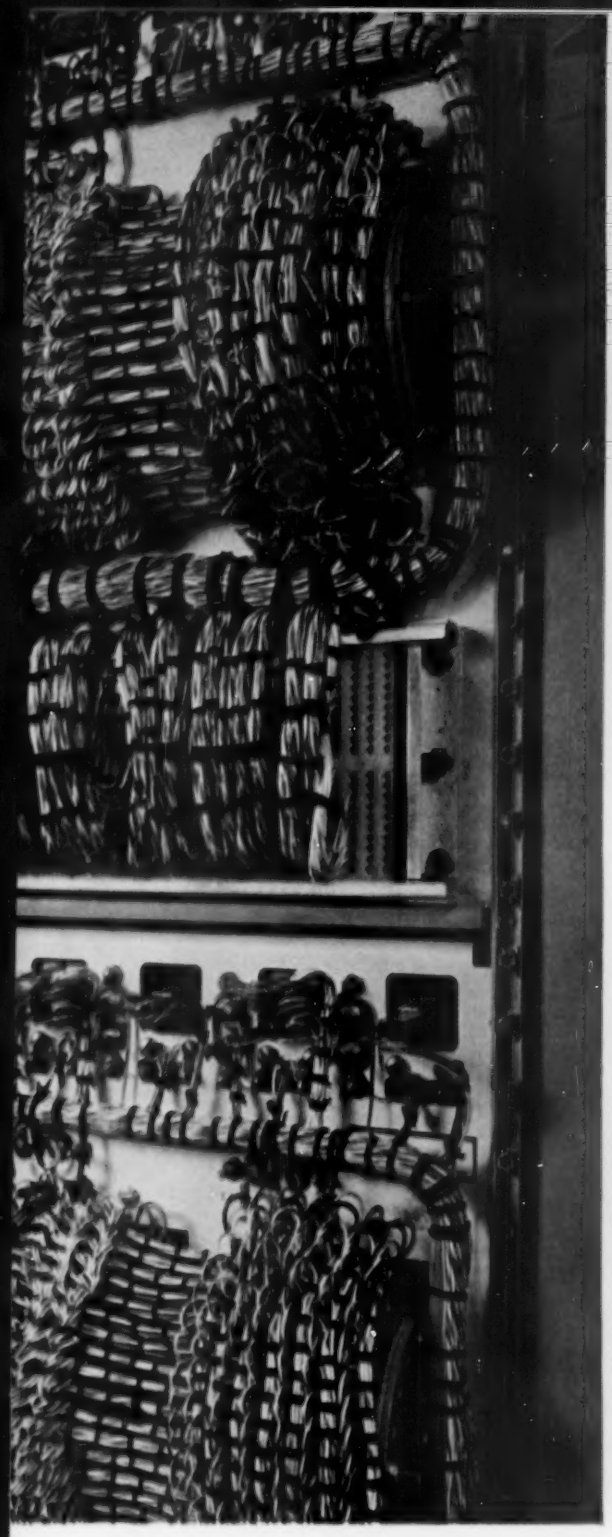
With its new methods, AMC has reduced the aircraft out of commission because of parts rate (AOCP) from a 1952 figure of 8.9% to 2.7% today. SAC bombers had a 14.2% AOCP rate in 1952; today's figure is .1%, Anderson said. Average shipment time for high priority items from U.S. to overseas has been cut from 12 days to six, and routine shipment time has been reduced by a third.

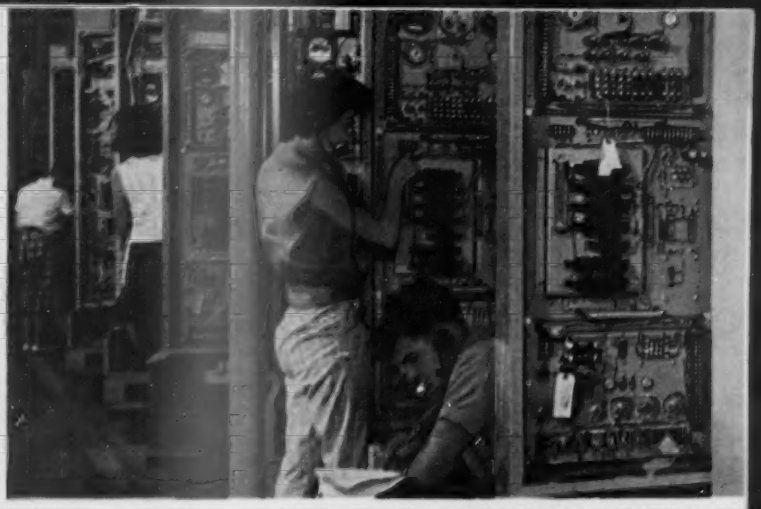
Air Force supply procedures are complicated by the need to blend the distinct requirements of aircraft, missiles, unmanned and manned spacecraft, Anderson said.

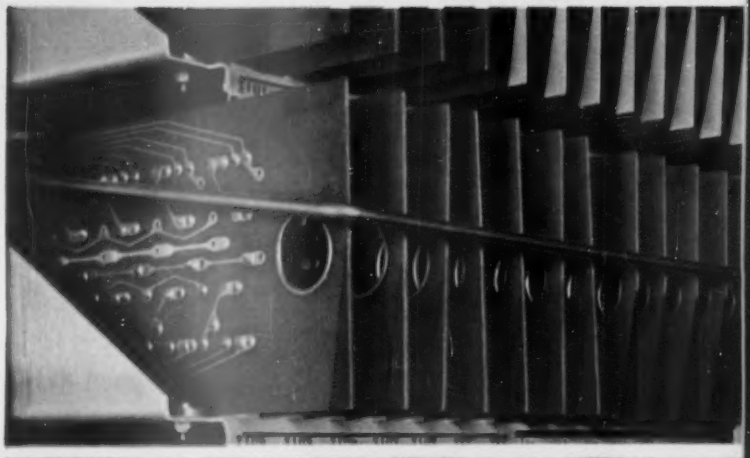
Installation of two International Business Machines 705 computers at San Bernardino Air Materiel Area has permitted continuous stock level monitoring of the 36,000 parts in Thor, 41,000 parts in Titan and 56,000 parts in Atlas. Usage rate in recycling and exercising missiles when they become operational can be determined by computers so that a yardstick is available on whether production of a specific item should be speeded up, slowed down or stopped.

By 1962, Ogden AMA, which will be the major assembly point for Minuteman, will have the same capability, Anderson said.

The AMC commander said USAF contract management needs strengthening, but added in some cases readiness and economy cannot go hand-in-hand. Legitimate criticism of procurement and pricing management is desired and is the basis for improvement, Anderson pointed out.







On guard against air attack—The Martin Missile Master electronic air defense system will protect ten major metropolitan areas by year's end. First installations have been delivered ahead of schedule and are now operational. According to the Army, Missile Master "will provide the most efficient and economical control and distribution of firepower available for the defense of strategic areas in the continental United States."

At 00h 00m 01s GMT, July 1, 1960, Martin logged its 590,304,000th mile of space flight

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LAUNCHED by a solid fuel rocket motor, North American drone, shown in artist's conception, will be used as a target in Nike and Hawk missile air defense crew training. It will be 19 ft. long and 1 ft. in diameter and will be designed to fly from subsonic speeds through Mach 2, and from ground level to over 50,000 ft. The stubby triangular wing will be removable in the field for low level flights.

North American Wins Army Drone Contract

Washington—North American Aviation's Columbus Division has received a $3.9 million Army contract to produce and flight test supersonic drones for use as targets in Nike and Hawk missile air defense crew training.

Army also has awarded a $3 million production contract to Beech Aircraft Corp. for the Model 1025 air defense missile target. Drone was developed as the KDB-1 by the Navy. It has 275 kt. speed, 40,000 ft. ceiling and one-hour endurance. KDB-1 is JATO or catapult-launched and is 13.5 ft. long and has a 12.5 ft. wing span.

The supersonic competition, in which more than 20 companies participated, was started more than a year ago when the Army pushed development of a versatile, high performance drone for both high and low altitude use (AW May 25, 1959, p. 32). North American vehicle will be 19 ft. long and one foot in diameter.

A 6-ft. triangular wing section, removable for low-altitude missions, can be fitted in the field for medium and high altitude flight.

Both winged and wingless configurations will be controlled by 3.5 ft. all-movable stabilizers.

The ground-launched drone will be capable of variety of speeds from transonic at sea level to Mach 2 at 50,000 ft.

Target will be launched by a solid fuel rocket motor, located under the body and dropped after burnout. Ramjet sustainer is located on top of the vehicle. Marquardt Corp. will build the sustainer motor; contract has not been awarded for the rocket motor. Recovery will be by parachute.

Army earmarked $4.7 million for target drone research, development, test and evaluation in Fiscal 1960 in a total target drone budget of $35.8 million. Fiscal 1961 Army target drone budget requests total $28.5 million, all for procurement.

IAM Ratifies Pact At Douglas Plants

New two-year contract involving International Assn. of Machinists' bargaining units at three Douglas Aircraft plants and Douglas facilities at four plane and missile bases was ratified last week. Pact covers 12,000 workers at plants at Santa Monica, Long Beach and El Segundo, Calif., at Vandenberg and Edwards AFBs, Cape Canaveral, Fla. and White Sands, N. M., proving grounds.

Contract terms provide for a 4 cent cost of living increment to be incorporated into the basic wage, plus fringe benefits worth 8½ cents an hour. Workers will get a 7 cent hourly wage raise in the second year.

In another labor dispute, negotiations last week broke down between the IAM and Lockheed Missiles and Space Division when agreement could not be reached over job classification and security provisions. Talks were recessed by federal mediators and pickets remained at Lockheed facilities at Sunnyvale, Van Nuys, Santa Cruz, Calif., facilities and at Vandenberg AFB.

Strikers also continued to picket eight plants of United Aircraft Corp. in Connecticut, although talks between management and two unions, the IAM and United Auto Workers, were still under way.

In Dallas, contract talks between Chance Vought and the UAW reportedly were centered on the length of a new contract, with the union demanding a one-year pact and Chance Vought insisting on two years. Sources said agreement had been tentatively reached on major issues.

Bell Helicopter has been negotiating at Fort Worth with two UAW locals (production and office workers) on reopener sections involving vacations, retirement and paid holidays. The company has offered an improved pension plan and says it is willing to discuss retirement. Negotiations currently are halted; union members have stayed away or walked off their jobs five times since May 27; the last walkout took place June 29. Pickets also appeared last week at Bell's Buffalo, N. Y., plant where similar clauses are open for negotiation.

Boeing Airplane Co. is negotiating with the IAM on a company-wide basis, involving facilities at Seattle, Wash., where the contract expired last Sept. 1, and at Boeing-Wichita, where the contract expired June 22. Production had not been interrupted, as of late last week.

Boeing offered a wage increase of 8 cents an hour for the first year and an additional 6 cents in the second year last Apr. 29; on June 17, this offer was increased by 2 cents in the first year and another cent in the second year.

Negotiations also are under way between the IAM and Rohr Aircraft Co., which has plants at Chula Vista and Riverside, Calif. Contract expires on July 9. Primary issue currently is seniority rights.

Tiros Interrogation Discontinued by NASA

Washington—Interrogation of the Tiros I photographic weather satellite has been discontinued temporarily because the weakened condition of its batteries has been causing erratic operation since early in June.

Tiros' orbit recently has been keeping it in the earth's shadow a great deal of the time. Lack of sunlight reduces battery-charging capability of solar cells, and low internal temperature may have affected internal circuits. It now is in sunlight most of the time, and attempts to obtain television transmission of cloud cover photographs from its wide- and narrow-angle cameras may be resumed, National Aeronautics and Space Administration said. Tiros was launched last Apr. 1 and has transmitted more than 25,000 pictures.

Meanwhile, the National Science Foundation has established a National Center of Atmospheric Research and named Dr. Walter Orr Roberts of the University of Colorado's High Altitude Observatory as its director. The foundation also awarded the University Corporation on Atmospheric Research a $500,000 contract to assist in creating the center.

After two years of consideration, the foundation decided to establish the small center rather than a larger national institute urged by several advisory groups. NSF Director Dr. Alan T. Waterman said the scientific community generally agrees that "universities should continue to play the leading role in basic research in the atmospheric sciences."

Supersonic Transport Called Vital to U.S.

Washington—An intensive program for development of supersonic transports must be initiated in the "very near future" if the U. S. hopes to retain its present role in international air transportation, the House Committee on Science and Astronautics warned last week.

In a report on supersonic transports, the committee said the nation that is first to produce such an aircraft will take the lead in air transportation. The report criticized the National Aeronautics and Space Administration for "what appears to be a reluctance on the part of NASA to assume management responsibility for any possible future program of research and development of a supersonic commercial transport."

Committee recommendations were:

- **That complete development** of the North American B-70 Mach 3 bomber move ahead quickly, since the B-70 program is closely tied in with the possible future development of a supersonic commercial transport.
- **That Congress make available** the money necessary to develop the supersonic transport.
- **That NASA take immediate** steps to assume leadership in devising an appropriate development program because of its "broad and very clear responsibilities in the field of aeronautical research and development."

The committee directed that NASA submit its detailed proposals to Congress as they are developed, together with recommendations for appropriate legislation.

Renegotiation Urged As Permanent Law

Washington—House Armed Services Committee has recommended that renegotiation be made permanent law as "an integral part of the way of doing defense business for the foreseeable future" in a report on Defense Department procurement practices.

The present renegotiation law expires June 30, 1962.

"The high incidence of negotiated contracting which is dependent, exclusively in some instances, and heavily in others on 'estimating' is fraught with dangerous possibilities of 'unjust enrichment' at public expense," the committee, headed by Rep. Carl Vinson (D.–Ga.), said.

"There has been a concentration of production facilities in the hands of a relatively small production base in which the government is heavily interested. This segment of industry, therefore, is the beneficiary of public necessity. Its position in relation to commercial enterprise and private taxpayers in the whole country, who support defense in equal measure demands that their fortuitous circumstance of position and place, shall not, by concentration of contracts produce excessive profits," the report said.

The committee report was promptly followed by House passage of legislation—also recommended in the report—aimed at increasing formal advertised bid contracting, increasing competition in negotiated contracting and establishing controls over fixed price incentive contracts (AW June 20, p. 75).

The measure, sponsored by Vinson, would require contractors on incentive type contracts to certify that their cost data is accurate at the time of negotiation of the target price, and at the completion of the contract an audit would be required to ascertain that the costs actually were accurate before the contractor could receive an incentive payment for savings from the target price.

Incentive contracts have been widely used by Air Force and Navy in aircraft and missile procurement, and they account for approximately 50% of USAF and 12% of Navy procurement dollars.

The House Armed Services report made these comments on different types of defense procurement contracts:

- **Cost-plus-fixed-fee.** This is a "high cost" operation. "The disturbing factor is the increasing use of this type of contract."
- **Firm-fixed-price.** This is "the tried and proven method, and when backed up by statutory renegotiation, can be a useful price tool. . . ." The report urged its wider use.
- **Price redeterminable,** and the alternative fixed-price-incentive. "The price redeterminable contract offers probably the soundest and more exact approach to the problem because of its reliance upon audit rather than estimates." The incentive type, as well as cost-plus-fixed-fee type, "are shrouded in the gravest doubts as to their effectiveness as contractual instruments."

Senate Group Seeks Acceleration of B-58

Washington – Senate Preparedness Subcommittee, headed by Sen. Lyndon Johnson (D.-Tex.), has urged an acceleration of Army modernization and the Air Force Convair B-58 bomber program. The reports urged the Secretary of Defense to study and take action on the two proposals.

The subcommittee said that the B-58 program "has been beset with funding difficulties, including the training program, which has been supported with only minimum funds" and that the first operational B-58 wing has been delayed from June, 1960 to January, 1961. In transmitting the report, Johnson commented that "a large percentage of the current operational manned bomber inventory is obsolescent and is not being replaced at a rate which would ensure the acquisition and maintenance of the most technologically advanced strategic strike force."

The weapons needed for Army modernization, the subcommittee observed, "are in existence."

The report gave these details on the status of Army missile requirements:

- **Little John.** "Substantial quantities are needed."
- **Sergeant.** "Only one-sixth of the active Army requirements are under contract."
- **Pershing.** "Only two are on order at present."
- **Hawk.** "Only one-third of active Army requirements are in production."
- **Redeye.** "None are in the hands of troops, although an urgent need exists."
- **Davy Crockett.** "Hundreds are on order when thousands are required."

News Digest

Evaluations are under way on advanced ICBMs beyond Minuteman to exploit gains in propulsion and guidance areas, according to Dr. Joseph V. Charyk, under secretary of the Air Force. Trend is toward a smaller ICBM with substantial payload capability, he said.

Leon A. "Jake" Swirbul, president of Grumman Aircraft, died on June 28 at the age of 62. Swirbul, one of the founders of Grumman in 1929, had been president of the corporation since 1946.

Douglas A4D Navy attack aircraft powered by the Pratt & Whitney J52 engine (AW May 9, p. 23) will be designated the A4D-5. The 8,500 lb. thrust J52, lighter than the J65 powering present A4Ds, will provide a 27% range increase. Other changes include an ejection seat providing ground-level bailout capability.

Kaman Aircraft Corp. has been awarded a $488,000 contract by Wright Air Development Division to apply a rotary wing recovery device, KRC-4 Rotochute, to space capsules, nose cones and rocket boosters. Rotochute weighs 196 lb. and utilizes helicopter-like blades for controlled descent.

Eastern Claims Strike Damages

Eastern Air Lines last week amended its June 7 complaint against the Air Line Pilots Assn. by asking for $11.4 million in punitive and other damages.

The carrier claimed that ALPA masterminded the walkout that crippled Eastern's operations for the 11 days ending June 22. Pilots who wanted to return to duty were "threatened and intimidated and otherwise coerced," the airline contended.

ALPA countered that Eastern's amended suit was "either a publicity stunt or a further attempt to harass the pilots." It insisted that ALPA played no part in the mass walkouts except to urge that the pilots return to work.

Meanwhile, two federal courts prepared to review the Federal Aviation Agency rule requiring the third pilot on board jet transports to relinquish his forward observer's seat to FAA inspectors checking aircrew competency.

Nominal defendants in Eastern's suit, besides ALPA, are Clarence Sayen, its president; the association's Master Executive Council; Council 18 of Miami and 18 ALPA officers of record.

Four-seat helicopter based on the Mil Mi-1 is being developed by the Soviet Union, according to Pravda. The new Soviet helicopter is amphibious and has a maximum range of 310 mi. when equipped with additional fuel tanks, according to designer Mikhail Mil. The Mi-1's range is 400 mi.

Kiwi-A Prime reactor is now scheduled for first and only full power run July 8 at Jackass Flats. Joint Atomic Energy Commission-National Aeronautics and Space Administration project will demonstrate feasibility of nuclear rocket engine. Kiwi-A 3 test will be held later this summer.

Pan American World Airways has signed an $89,162,000 contract with Air Force for Fiscal 1961 operation and maintenance of the Atlantic Missile Range. This is $2,932,000 more than the previous year's contract. The company's fixed fee remains the same as it was for Fiscal 1960—$1.75 million. Pan American assumes a number of technical functions previously performed by its principal subcontractor, RCA, including evaluation and monitoring of instrumentation contracts and most range instrumentation planning.

Soviet Union claims new world speed and distance records for helicopters flown by women. A single-rotor Mi-1 helicopter piloted by Tatiana Russiyan covered a 500-km. closed course at an average speed of 142.642 km. per hr. (88.58 mph.). Flight started and ended at Moscow's Tushino Airdrome.

Senate Appropriations Committee last week recommended abolishing a $58 million limit set by the House on spending of Atomic Energy Commission funds for the reactor part of the Aircraft Nuclear Propulsion program. Committee approved the over-all AEC figure of $73 million for the program, $41.5 of which is for the General Electric direct cycle engine and $27.5 million for the Pratt & Whitney indirect cycle. If the limit remains in the bill, GE is expected to have to absorb most of the $9 million cut in reactor money.

Army-Chrysler Jupiter has been eliminated as a target missile for Nike Zeus anti-missile tests, and construction has been halted on the Jupiter launch site at Johnston Island. Eighteen USAF-Convair Atlases will be bought instead for firing from Vandenberg AFB, Calif. under Army direction, and Atlases fired by USAF training crews also will be used as targets.

Avro 748, British turboprop feederliner, made its first flight recently after 17 months from the time a decision was made by A. V. Roe to proceed with the project.

American Machine & Foundry Co. has been awarded an $81,567,000 USAF contract for construction of 36 launcher systems for the Titan ICBM. AMF will produce the systems at its Titan production division, Greenwich, Conn., and at the company's Buffalo, N. Y., plant and will install them in four western states.

Avianca has selected the Boeing 720B intermediate range jet transport, powered by Pratt & Whitney JT3D-1 turbofans, for jet service between New York, Jamaica and Colombia. Order is for two aircraft at a cost of $13½ million.

Curtiss-Wright will move its Skydart rocket-powered target program (AW July 6, 1959, p. 85) from Santa Barbara, Calif., Division to the Propeller Division at Caldwell, N. J., following USAF decision not to use Skydart in operation training. Company instead will build 20 targets for U. S. Navy's Sidewinder training program. In another Santa Barbara move, C-W's small gas turbine project goes to Aeronautical Division at Wood-Ridge, N. J. Personnel are being given transfer opportunities. Santa Barbara will retain avionic work, under general managership of Jack O. Charshafian.

Discoverer 12 satellite last week failed to enter orbit when Thor Agena vehicle apparently did not generate sufficient velocity after launch from Vandenberg AFB, Calif. It was the fifth failure in 12 shots.

Soviet Rocket Tests

Washington—Soviet Union will launch a new series of powerful multistage rockets into the Central Pacific between July 5 and July 31 "for scientific research and experimental designing in the sphere of space problems," the Russian news agency Tass said last week.

Russia warned aircraft and ships to stay clear of a 50,000 sq. mi. area some 1,000 mi. southwest of Hawaii. The area is about 150 mi. farther to the southeast—and therefore farther from Russia—than the impact area announced for similar tests earlier this year (AW Jan. 18, p. 29). Tass said the rockets will be fired without their final stages.

Tass said the type of rocket tested last January was used to launch the 5-ton Sputnik IV spacecraft on May 15 (AW May 23, p. 27).

Cargo Award Spurs Turboprop Activity

Small carriers win Logair contracts worth $25 million; force cutbacks for Slick, AAXICO, Resort.

By David H. Hoffman

Scott AFB, Ill.—Military Air Transport Service last week awarded four small U. S. carriers more than $25 million in Logair contracts after a bidding contest that promised to spark these repercussions within the industry:

- **High dollar turnover** for Capitol Airways, Inc., World Airways, Inc., Zantop Air Transport, Inc., and Riddle Airlines, Inc.—the four successful carriers.
- **Phase-in of the first all-cargo,** turboprop transports to enter U. S. commercial service—Armstrong Whitworth's AW.650 Argosy and Lockheed's C-130B Hercules.
- **Drastic revenue cutbacks** for Slick Airways, Inc., AAXICO and Resort Airlines, Inc.—three carriers that last year shared the bulk of Logair business.
- **Full commercial certification** for the C-130B.

Mileage Increase

The contracts, effective through Fiscal 1961, total 33,918,110 route miles and a volume of $25,301,185. They involve about a 13% increase in Logair scheduled mileage, a 25% increase in Logair annual expenditures and a substantial increase in the cargo capacity of the Logair fleet.

Monetarily, Capitol emerged from the competition on top with $10,556,402.37 worth of contracts to provide Curtiss C-46 service on four route patterns encompassing 19,575,500 stat. mi.

An uncertificated carrier that specializes in hauling parts for Detroit's automotive industry, Zantop won a $5,289,409.96 contract to carry Air Force "outsize cargo" (AW Mar. 14, p. 39) along two long-range route patterns totaling 4,878,200 stat. mi.

To qualify for the contract, Zantop agreed to purchase five C-130Bs from Lockheed. All Air Materiel Command requirements for the carriage of jet engines and other bulky hardware between aerial ports, Strategic Air Command bases and maintenance depots within continental United States are met by this 135,000 lb. gross weight freighter.

First of the five C-130Bs is scheduled for phase-in on Mar. 31, 1961—the deadline specified by Air Force when it invited 96 U. S. carriers to submit outsize cargo proposals about three months ago. Last Zantop Hercules is scheduled to begin service by June 20, 1961. According to Lockheed, fly-away price of the C-130B is about $2.5 million.

Conferences with Lockheed personnel in Marietta, Ga., convinced Zantop that it could quote a C-130B plane mile price of $1.97 to the Air Force and still earn a reasonable return.

Pending delivery of the C-130Bs Zantop will fly its new routes with eight Douglas C-54s. These aircraft were acquired from Lockheed, a Miami broker, AAXICO, Twentieth Century Airlines and two maintenance outfits in California.

Riddle, which won a $4,968,516.32 outsize cargo contract covering 4,598,300 route miles, bid on the basis of a five-plane purchase of AW.650s. Costing about $1.31 million each, the Argosies are programed to enter Riddle service beginning Dec. 20. Last aircraft will be introduced by Feb. 10, 1961, according to present schedules. In the interim, Riddle will operate 10 C-46s along Logair routes.

World, a supplemental air carrier based in Oakland, Calif., broke into Logair business with a 5,110,300 stat. mi. contract worth $4,486,856.57. After learning of the contract's award, World leased five C-54s, bringing its combined fleet to eight C-54s and four DC-6A/B aircraft purchased earlier from American Airlines. It also hired 54 additional pilots and increased its labor force from 80 to 275 personnel.

To illustrate the highly competitive character of the Logair bidding, and the role it can play in a small carrier's financial future, Slick lost out to World by only $921.43. As a direct result, Slick will lay off 120 employes, including about 65 pilots, and dispose of nine aircraft on the used plane market.

The carrier also is seriously considering cancellation or postponement of its commitment to purchase two Canadair CL-44 four turboprop freighters that are due for delivery next year (AW June 27, p. 41). Only by diversifying into other fields, a Slick management source reports, can the carrier hope to keep its organization intact.

Last stable revenue source for Slick is its regular MATS transocean contract, which expires on Sept. 30.

In an attempt to cut lead time on C-130B deliveries, Lockheed apparently has reversed its decision to seek a unique "turbine power, all cargo" certificate that would authorize commercial carriers to use the Hercules on the Logair mission. As of last week, the company intended to put the aircraft through a full Federal Aviation Agency certification program, feeling that in the long run this approach would prove less time-consuming. Certification of the transport should take at least six months.

Proving Program

Armstrong Whitworth, meanwhile, is just concluding a European route proving program with its AW.650, to be followed this month by British certification of the 88,000 lb. gross weight transport.

This certification, Armstrong Whitworth believes, should satisfy the Federal Aviation Agency after 12 minor items on the AW.650 have been added or modified to American standards. They include fire protection in cargo and baggage compartments, high intensity wing lighting, flare installations, rearranged flight engineer's seat and flap and radio console changes.

Officers representing three of the four low-bidding carriers emphasized to AVIATION WEEK that sharply increased profits probably would not go hand-in-hand with the Logair contracts. Capitol's President Jesse F. Stallings pointed out that his company had to bid about 54 cents per C-46 aircraft mile to win this year's contract.

Last year, Capitol landed a Logair contract by bidding 59.5 cents per mile, Stallings said.

A mainstay of Logair for six years, Capitol will fly 40 C-46s on its new

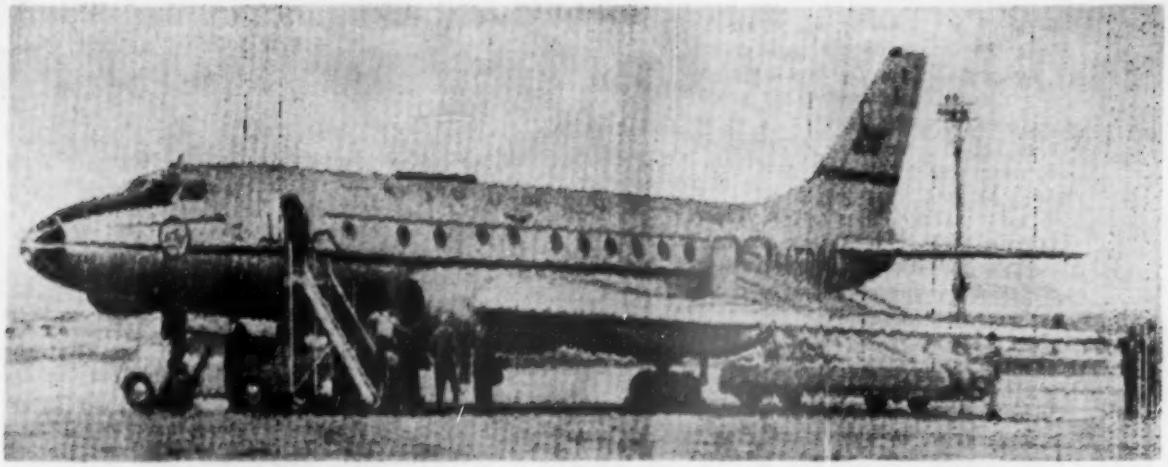
Slick Diversifies

Slick Airways, Inc., will purchase the Illinois Shade Cloth Corp. for $6 million as part of a diversification plan to broaden its financial base.

Illinois Shade Cloth, the country's second largest manufacturer of window shade cloth, earned $500,000 on sales of $8 million in 1959.

No changes in either management or function of the acquired corporation are planned.

Slick drew about half of the purchase price from working capital and the other half from long term bank loans, according to A. W. Johnson, the carrier's executive vice president.



First Photo Shows Soviet Tu-124 Turbofan Transport

First photo of Soviet Tu-124 transport confirms report in Aviation Week June 6 issue, p. 37, that this aircraft is powered by two Soloviev turbofan engines. The Soviet Union has begun serial production of the Tu-124, according to an interview with the aircraft's designer, Andrei Tupolev, published in Pravda. The turbofan engines are said to give the transport outstanding fuel economy. Tupolev told Pravda the Tu-124 cruises faster than the Tu-104 and has a maximum speed of about 1,000 km. (620 mph.). The Tu-104 has a maximum speed of 560 mph.; the Tu-104A's maximum speed is 600 mph. The Tu-104B has flown at 631 mph., according to the Soviets (AW Aug. 10, p. 27). The aircraft seats 44 passengers in its three-section cabin, which is equipped with tables and 24 chairs, plus 20 folding seats. The Tu-124 resembles the Tu-104 in external configuration.

routes. Twenty of the aircraft will be leased from AAXICO, last year's leading Logair carrier. To cope with its new commitments, Capitol plans to add 190 more pilots to its present roster of 160.

For Riddle—a carrier with operating costs in excess of revenues by $7.5 million over the past four years—the Logair award may be a financial lifesaver. Assuming that the contract can be renegotiated for two additional years, Riddle would be assured of an extra $20 to $25 million in gross revenues payable through Fiscal 1963.

Terms of the actual contract, however, hinge this privilege of renegotiation upon the availability of the funds, the continuation of airlift requirements as well as the satisfactory performance by the carrier.

Nevertheless, Riddle, with a guaranteed daily schedule of 12,600 mi. and five modern freighters in its fleet, is at least anchored to withstand the impact of heightened trunkline competition for available air cargo.

Riddle bid the Argosy at $1.65 per plane mile and feels that one AW.650 is equal to at least two C-46s in cargo capacity.

Zantop Plans

Now a daily operator along routes that stretch from California to Pennsylvania, Zantop intends to base its C-54 fleet at Macon, Ga., and Travis AFB, Calif. When the C-130Bs are phased in next spring, Olmstead AFB at Middletown, Pa., will be substituted for Macon and the C-54s will be phased out.

Zantop's agreement with the manufacturer includes a clause that Lockheed will oversee transitioning of Hercules aircrews.

The season of peak activity for Zantop, which coincides with automobile manufacturers' changeover to 1961 styles and which just now is getting under way, complicates the carrier's inauguration of Logair service.

The long-standing argument over whether the military should do business with non-certificated air carriers was revived by Zantop's capture of the $5 million Logair contract.

Certificated carriers contend that only they return a real contribution to the industry—in equipment development and Civil Reserve Air Fleet participation, for example. At the same time, their higher costs, largely stemming from unionized labor forces, are handicapping them in the scramble for government contracts.

Thus the certificated airlines, which include Slick in the cargo field, maintain that Air Force airlift augmentation contracts should be awarded only to those carriers directly responsible to the Civil Aeronautics Board.

Congress Extends Life of Supplementals

Washington—Congressional approval last week of stopgap legislation extending the operational life of supplemental airlines may have set the stage for a full-scale investigation next year of the carriers' status by Senate and House aviation subcommittees.

Pointing out that sufficient time is needed to study supplemental authority, which was challenged by the U.S. Court of Appeals as illegally granted by the Civil Aeronautics Board (AW June 6, p. 43), legislators approved bills which would permit the airlines to continue under their present authority. House set a one year limit, and the Senate approved the authority for two years. Agreement on the extension time limit was expected late last week.

Earlier, the airlines averted a June 7 court deadline, which would have had the effect of suspending their operations, by asking the Supreme Court to review Appeals Court decision. The carriers have thus been able to continue unrestricted domestic charter operations and their 10-trips-a-month authority between any two cities pending either action on the Supreme Court appeal or legislative relief from Congress.

Congress clearly indicated that it acted only in the interest of granting the airlines a reprieve from the court order and that it may consider curbing some of the supplementals' operating privileges in the future.

A bill offered by the CAB would grant the airlines permanent certificates for limited operations, while relaxing some of the financial standards currently applied as a fitness qualification for certification. No action was taken on the Board proposal.

Rep. Harold R. Collier (R.-Ill.) noted that he had intended to amend the stopgap legislation to confine supplemental airlines to charter operations, as suggested in the past by CAB Vice Chairman Chan Gurney, "which I am convinced is their proper sphere," but had refrained from doing so because of hearings planned for next year by House Commerce Committee. Senate Commerce Committee also plans hearings next year.

Il-18 Turboprop Transport Operated by Soviets in Arctic

Ilyushin Il-18 turboprop transport above is one of the new aircraft being operated by the Russians in the Arctic region. It is shown at Norilsk in the markings of Polar Aviation, a branch of the Main Administration of the Northern Sea Route. Early this year the Polar Aviation organization, its personnel and equipment were transferred to Aeroflot, the Soviet civil airline, and became the Directorate of Polar Aviation of the Civil Air Fleet, which is headed by Gen. M. I. Shevelev. Under Aeroflot direction the Polar Aviation group has opened scheduled service to several cities within the Arctic Circle as well as carrying out its previous duties of supplying arctic settlements and expeditions on an unscheduled basis, performing rescue operations and assisting in the forecasting of ice conditions during the Arctic Sea navigation season. Main Administration of the Northern Sea Route received high level criticism last year because its ice forecast was only 70% correct, and a number of supply vessels carrying heavy supplies north were stranded. A specially designed light weight television unit has been placed in series production and is being supplied to Polar Aviation for use on the aircraft which participate in the ice forecasting work. Scientists on the ground prepare their ice formation predictions by visually monitoring the television pictures from the aircraft. This system has proven to be a great improvement over the old method of analyzing aerial photographs. First scheduled airline service into the Russian Arctic will be from Moscow beyond the Arctic Circle to Norilsk and Tiksi over a route of more than 3,000 mi. This route will later be extended to the Kamchatka peninsula. Aircraft in service with the Directorate of Polar Aviation include the Il-18, An-10, Il-14 and Tu-4 (B-29 copy) transports and the Ka-15 helicopter.

Yanagita Calls for Lower Fares To Prevent Excess Competition

Washington—Seijiro Yanagita, president of Japan Air Lines, called for lower fares, better service and pooling arrangements last week as means of preventing excessive competition that could force flag carriers of smaller nations out of business.

In an address here before the Aviation/Space Writers Assn., Yanagita, who is also president of the International Air Transport Assn., said he does not believe there is too much competition on international routes at the present time. He noted, however, that increased capacity of jet aircraft poses a threat of available seat mile increases that could further depress revenues and create new deficits.

"Unless an airline can operate at a profit, it should not stay in business, unless its government wants it to stay in business so badly that it is willing to underwrite its losses. This is not, in my opinion, either practical or sensible . . . I assure you that unless Japan Air Lines can operate at a profit, our government will tell us to get out of business, and I assume that other airlines are faced with similar situations," he said.

Yanagita said that lower fares, better service and more comfort will "allow more airlines than exist today to carry more people farther and with greater frequency and still make an operating profit." He suggested that one solution to the problem of aircraft utilization stemming from larger aircraft lies in pooling of equipment, traffic and maintenance and "in some cases even pooling revenues."

The industry's "great hope is that fares will go down," Yanagita observed. With prices down, he said, travel will be stimulated and aircraft will be operated at adequate load factors.

Yanagita opposed complete and open exchange of all traffic information, which has frequently been proposed in the past as a means of controlling flight frequency and aircraft capacity. He admitted there is room for exchange of such information on a voluntary basis but added that compulsory exchange would damage free competition and would "actually make every member of IATA a member of an international cartel."

On the subject of Russia's role in international air transportation, Yanagita emphasized that Aeroflot, the Soviet airline, has been formally invited to join IATA. He said the invitation has not been accepted and added that "personally, I would be pleased to sit at the conference table with the directors of Aeroflot."

He said he hoped that Russia will ease restrictions such as those preventing polar flights over Siberia but noted that, until the USSR elects to be represented in IATA, "I, for one, assume she is disinterested in international aviation, preferring to operate along the lines of a domestic service." He said that 100 years ago, Japan gave up such a doctrine of isolationism and added:

"Perhaps Russia will some day do the same. Meanwhile, whether the rest of the world is to be permitted across Russia's vast lands is for the USSR to decide—not for IATA to discuss."

Engineers Ask Broader FAA Regulation

Washington—Flight engineers' demands that any new Federal Aviation Agency regulations provide more formal and detailed recognition of engineers as technical specialists necessary to safe airline operations were opposed by the airlines and Air Line Pilots Assn. at FAA hearings last week.

Air Transport Assn. urged that FAA drop its present requirement for flight engineers on all transport aircraft exceeding a gross takeoff weight of 80,000 lb. and asked that the decision to use an engineer, along with standards for his training, be left to the judgment of carriers and manufacturers. ATA testified during a general review of FAA flight engineer rules.

Air Line Pilots Assn. backed the ATA stand and said that existing jet aircraft designs require more demanding navigation and communication duties than mechanical work. Because of this, ALPA said it is increasingly important that all crew members be qualified to relieve each other, thus requiring a closely coordinated flight deck layout without separate flight engineer stations.

FAA ruled out any debate at the hearings on the third pilot issue and served notice on ATA that the full hearing agenda would be considered. The association had noted "grave concern" over the degree of standardization, regulation and special flight engineer duties suggested by the hearing agenda, calling them "incompatible" with industry experience.

Flight Engineers International Assn. told FAA that its 80,000 lb. gross weight rule is basically sound and should remain in effect, regardless of the number of engines involved. The need for close monitoring of powerplants by the engineer is intensified on twin engine aircraft exceeding this weight limit, the union said.

Aircraft cockpits should be designed with built-in crew coordination, permitting the engineer to monitor and adjust all necessary instruments and controls without leaving his seat, according to FEIA. The engineers contended that many instruments are too small for adequate daylight reading and others are difficult to read at night because of the low level of illumination required by the pilots. They also feel that present operating manuals fail to clearly spell out specific crew member duties and should be clarified to reflect new civil air regulations being considered at the hearing.

New jet aircraft are so complex that it is nearly impossible for flight engineers to keep qualified on more than one type, FEIA said. The union urged FAA to change its rules to require type ratings for specific aircraft, proficiency checks every six months and accurate records. Exact duties of the engineer also should be spelled out by FAA to include such items as preflight inspection, inflight maintenance, operation of powerplant system controls and information on mechanical malfunctions, the union said.

Training and certifications for flight engineers "borders on the ragged edge of safety," said FEIA, and fails to provide minimum standards. Present regulations, the union charged, are open to wide interpretation so that training programs vary from airline to airline and must be brought up to a minimum standard of safety.

"If there was any doubt in our minds as to the need for increasing training requirements and experience to perform the flight engineer function, the jet eliminated it," FEIA President Ron Brown said.

ATA urged that any reference to aircraft weight or number of engines be dropped from the regulations requiring a flight engineer and be replaced by an FAA determination issued as part of the aircraft certification. Crew complement should be specified on the basis of demonstrations made by the manufacturer which would point out pilot workload and accessibility of controls to crew members, according to ATA.

The airlines also opposed FEIA's demands for type ratings for engineers, and contended that the new turbine aircraft are not as complex as the engineers claim. As an example ATA compared the operational simplicity of turbojet engines, such as the J-57, with piston engines.

FEIA countered that while turbojet engines have fewer total parts, there is still a wide difference in instrument control panels between jet and piston aircraft. Boeing 707s have 345 instruments for the pilot and 209 for the flight engineer, compared with the 1049G Constellation which has 255 pilot instruments and 274 flight engineer instruments. In addition, the engineers contend, the turbojet aircraft has twice as many electrical circuit breakers to monitor.

The airlines believe flight engineers should be permitted to hold either a flight engineer certificate or commercial pilot certificate, on the basis that they would be subject to current FAA training regulations. ATA said such a move would be a "recognition in fact" of the current airline practices, since many carriers employ pilot-qualified engineers while others have mechanic qualified engineers.

FAA should adopt the concept that the flight engineer's primary purpose is to assist the pilot and direct its efforts towards regulating flight crews as a unit, ATA said. Airlines opposed any further expansion of training regulations for flight engineers on grounds that existing regulations already require the carriers to have their training programs approved by FAA.

TWA Attendants Win Wage Boost

New York—Wage increases of 8% across the board without differential for jet aircraft and a reduction in monthly flying hours have been awarded to hostesses and pursers of Trans World Airlines, it was announced by David J. Crombie, vice president-industrial relations for TWA.

Adjusted paychecks retroactive to May 1, 1959, will be mailed to hostesses and pursers by July 15, Mr. Crombie said. The awards, following eight months of arbitration proceedings, were made by a board consisting of David L. Cole, chairman designated by the National Mediation Board; Lee Leibik, attorney for the Air Line Stewards and Stewardesses Assn.; and John P. Mead, assistant vice president-industrial relations for TWA.

The increase of 8% in wages will be effective from May 1, 1959, to Feb. 1, 1961, at which time it will be increased by another 5% through the life of the contract, expiring on Feb. 1, 1962. Hostesses who flew jet aircraft before May 1, 1959, will receive retroactive increases from the day they started flying jets. In addition, expense allowances for domestic hostesses have been increased from 32 to 35 cents per hour of flying time, retroactive to May 1, 1959.

Maximum jet flying hours have been established at 78½ hr. per month for domestic and 235½ hr. per quarter for international cabin attendants. Piston flying hours remain unchanged. Newly established flying hours on jets are to become effective by Sept. 1, 1960. For international cabin attendants flying more than 70 hr. in any one month, premium rates were increased from $3.75 to $4.25/hr.

The union had asked for a higher rate of pay on jet aircraft than on piston aircraft, which was not allowed. The union was also denied its request to represent foreign attendants who fly TWA aircraft beyond European gateways.

Capital Asks to Drop Light Traffic Points

Washington—Capital Airlines asked the Civil Aeronautics Board last week to eliminate points on its system which "possess local service and low traffic density characteristics" as a means of strengthening its present route structure.

In a letter to Board Chairman Whitney Gillilland, Capital President David H. Baker said that elimination of service to such points would permit the carrier to accelerate the retirement of its DC-3 and DC-4 fleets. He said this would eliminate repeated cycles of costly overhauls and modifications and that as a short-haul regional trunkline, the airline is in no position to re-equip with new aircraft to serve uneconomic local service and low density routes.

Meanwhile, prospects for the carrier's future brightened when it was granted a fourth extension in the $33.8 million foreclosure suit brought against it by Vickers-Armstrongs, Ltd., British manufacturer of the Viscount turboprop transport operated by Capital. The extension gives the airline until July 14 to answer the complaint.

In addition, the airline has presented a financing program to the British creditors which is now under consideration. Vickers has also granted the company permission to pay some $225,000 of interest due July 1 on its outstanding subordinated convertible debentures. Capital also is slated to bring its interest payments on the Vickers loan up to date with a July 1 payment.

Here are the points which Capital wants eliminated from its system:

- **Elimination of Route 41,** which serves Sault Ste. Marie, Pellston and Traverse City. Capital said a local service carrier has already been recommended to provide service at these points.
- **Elimination of Wheeling,** Morgantown and Clarksburg in West Virginia from a route between New York and Pittsburgh and the South. Local service operations have also been recommended for these cities, the airline said.
- **Elimination of a route** serving Buffalo-Erie-Pittsburgh and elimination of Erie on a second route serving Buffalo. Capital stated in its letter that an initial CAB decision has recommended that the airline be permitted to suspend these services and that a Board examiner had found that a local service carrier should provide this service.
- **Transfer of a Norfolk**-Elizabeth City-Rocky Mount-Raleigh-Greensboro-Winston-Salem-Charlotte-Hickory-Ashville-Knoxville route to Piedmont Airlines, as recommended by the CAB Bureau of Air Operations.
- **Elimination of Harrisburg**/Williamsport and Elmira from a route serving Buffalo. The airline suggested that replacement of service to these cities by Allegheny Airlines is "indicated to be clearly in the public interest."
- **Elimination of Muskegon** on its east-west route.
- **Elimination of Raleigh,** Greensboro, Winston-Salem and Charlotte as intermediate points on a segment of a route between New York and New Orleans.
- **Elimination of Toledo** on an east-west route. Capital said local service between Toledo and Detroit, Youngstown, Akron and Pittsburgh have been recommended for a local service carrier in the Great Lakes Local Service Investigation.
- **Elimination of a segment** of a route between New York and Norfolk. Capital said that it is certificated together with National Airlines to provide service between Newport News and Norfolk, only 23 mi. apart, and between Philadelphia and New York, only 95 mi. apart. It added: "Competitive trunkline service in these short-haul markets makes for an inherently uneconomic operation that cannot be justified in the public interest under present circumstances."
- **Elimination of Baltimore** on a route between New York and the South. The airline said three carriers, including Capital, are certified at Baltimore on this route, and that total traffic flows are inadequate to support service by three carriers.
- **Elimination of Richmond** as an intermediate point on a segment of the route from New York to the South. Capital wants Richmond as a terminal on its east-west route between Minneapolis and Chicago and Norfolk via Washington.

The airline said it intends to file for withdrawal of its applications for route extensions pending in six CAB dockets.

In his letter, Baker stressed that Capital's route structure was originally designed to fit operating performance of the Boeing 247D and the Douglas DC-3. He added:

"Since then technological progress in the aeronautic art has advanced rapidly. The progressive advent of pressurized, piston-powered aircraft, turboprop airplanes and pure jets have clearly outmoded operating patterns geared to the DC-3 and similar type equipment."

He said that Capital, as a regional trunk carrier, finds it costly to provide volumes of local service and added: "Equipment, operational and scheduling problems are compounded in an effort to meet the requirements of both local-service and trunkline service markets."

Stalemate Likely on Mail Airlift Ban

Washington—After lengthy hearings this year and last, Congress is expected to leave the decision of whether regular first class mail should be airlifted on a space available basis to the Post Office Department, which favors the program.

House Post Office Committee has approved legislation, urged by railroad interests (AW June 13, p. 45), which would ban transportation of mail with first class postage by air. Even if the House were to approve this measure, the Senate Post Office Committee can be counted on to bury it. The Senate committee approved legislation last August clarifying the authority of the Post Office Department to airlift surface mail in the interests of improving postal service.

While the House group has been considering its ban on surface mail airlift, the department has been quietly expanding the program. Seven new routes, including the first New York-San Francisco service, have been added in recent weeks, and another 13 new routes are scheduled. An estimated 1.5 billion pieces a year of first class mail have moved over the routes established since the program was started in 1953, and the department expects the 20 new routes to increase this annual volume to 2.4 billion pieces.

In a report to the committee strongly opposing the legislation which the group adopted, Postmaster General Arthur E. Summerfield said that the ban would "force millions of postal patrons to accept mediocre mail service because the Department could not take advantage of modern, more expeditious modes of transportation even though available at no additional cost." He said it would "create a truly chaotic condition at a time when the postal system is literally bursting at the seams with a far greater volume than ever before."

Discontinuance of mail-carrying passenger trains, plus the fact that remaining rail services are scheduled at hours attractive to passengers but poor for mail, Summerfield reported, has aggravated the problem of mail service. He said 386 mail carrying passenger trains were discontinued in 1958 and 1959 and that discontinuance of 87 more is contemplated during the first six months of 1960. He commented that "passenger train service is going to continue to decrease whether or not first-class mail is airlifted."

SHORTLINES

▶ **Continental Airlines** plans to file exceptions to Civil Aeronautics Board Examiner Edward Stodola's recommendation in the Southern Transcontinental Case that Continental be denied routes from Houston, San Antonio and El Paso, Tex., to San Francisco and from Dallas/Fort Worth, Lubbock, Midland/Odessa, Tex., and Albuquerque, N. M., to San Francisco, Los Angeles and San Diego, Calif. Continental says it believes it can convince the CAB there is a need for a "flexible regional carrier" serving these routes. Examiner recommended a new route for Continental from Houston, San Antonio and El Paso to Los Angeles, San Diego and Long Beach, and the airline said it would begin service as soon as the Board hands down a final decision in the case.

▶ **Civil Aeronautics Board** has suspended a United Air Lines tariff revision which would have raised coach fares more than the tariff increase of 2½% plus $1 which the Board recently authorized.

▶ **Eastern Air Lines** began a new all-freight service last week operated with six flights a week, from Miami to Atlanta and Chicago using converted Lockheed Super-C Constellations. The new service provides same-day connections for San Juan, P. R., and New Orleans and Houston. Eastern had previously initiated similar all-cargo service connecting the New York/Newark metropolitan area with Atlanta, Mobile, New Orleans, Houston, Miami and San Juan.

▶ **Pacific Air Lines** was scheduled to begin a new weekend excursion fare flight from Lockheed Air Terminal, Burbank, Calif. to Las Vegas, Nev. July 1. The one-way fare of $12.50 will apply to the new service as well as to two daily coach flights Pacific operates from Burbank to Las Vegas.

▶ **Seaboard & Western Airlines** has opened a new sales office at Houston International Airport. The all-cargo carrier operates two daily transatlantic flights out of New York and has interline agreements with other carriers operating from inland U. S. points to New York.

▶ **TABSO,** the Bulgarian state airline, has begun weekly flights from Sofia to Copenhagen, via Vienna and Berlin. The Bulgarian airline says it will begin service from Sofia to the Middle and Near East, Paris and other European cities "shortly."

AIRLINE OBSERVER

▶ Design, metallurgical and fabrication factors are all involved in failure of compressor disks on Rolls-Royce Tyne Mk. 12 engines (AW June 6, p. 43). Possibility of a random metallurgical defect in a particular batch of disk metal has been discounted, and special emphasis centers on heat treatment of the disks during fabrication. Modifications probably will involve at least the replacement of the disks forming specific compressor stages. Indications are that a refit program is not likely to delay entry of the Tyne-powered Vanguard into service by more than six to eight months. Rolls-Royce is expected to give Vickers a revised engine schedule delivery at a meeting of the two companies to discuss the nature and extent of the failures and the fix proposed.

▶ **Tourist class services on the North Atlantic officially ended last week, completely replaced by the lower-fare economy class. International Air Transport Assn. estimates that 3 million passengers have used transatlantic tourist services since the class was introduced eight years ago. Tourist traffic accounted for 76.4% of all scheduled transatlantic traffic in 1957 but, dwindled to 4.7% in 1959 following the introduction of the economy class in April 1958.**

▶ Six international airlines have established spares and engine pools for Douglas DC-8 turbojet aircraft at 25 strategic points throughout the world. Each member of the pool may draw on the spares at any time. Participating airlines are: Alitalia, Japan Air Lines, Pan American, KLM, SAS and Swissair.

▶ **Lufthansa, Sabena and TWA are making biggest strides in increasing their shares of all traffic carried by the scheduled airlines on the North Atlantic so far this year. In one recent week, TWA carried the largest single share—20% of all eastbound transatlantic passenger traffic.**

▶ Aeroflot has started its first large-scale shipment of fresh berries and fruits from southern growing areas to Moscow. Over 16.5 million lb. will be flown to the Soviet capital during the summer.

▶ **United Air Lines craft and determination hearings before the National Mediation Board came to a close last week. Hearings, which began eight months ago, were opened when Air Line Pilots Assn. asked the NMB to hold elections on United Air Lines for a new craft and class called "flight deck crew member." Successful election would transfer United's flight engineers, who are pilot-trained, from the jurisdiction of Flight Engineers International Assn. to ALPA.**

▶ Wide-scale transportation industry development program has been urged by John J. Allen, Commerce Department under secretary for transportation. Allen has called for establishment of a program by top transportation executives that would detail present problems of the industry. Results of intensive research on these problems by consultants and universities would serve as a basis for the over-all industry development program.

▶ **Maj. Gen. John S. Bragdon (USA Ret.) took oath of office last week as a member of the Civil Aeronautics Board to fill out former Chairman James Durfee's term, which expires Dec. 31. Gen. Bragdon has been special assistant to President Eisenhower for public works since 1955.**

▶ Trans World Airlines will convert six Lockheed 1649 Constellations to freighter configuration this summer in a $1.5 million program designed to double the carrier's transatlantic cargo capacity. The 6,000 mi. range 1649 freighters will be flown between New York and London, Paris, Rome, Milan, Frankfurt, Zurich and Geneva.

▶ **Small air carriers have been asked to fly National Aeronautics and Space Administration cargo and passengers between key NASA operating bases in southeastern U. S. Solicited by Military Air Transport Service, bids are to cover scheduled air service for an 11-month period beginning Aug. 1. Specifications set out in the MATS request indicate that routes will be flown with Douglas DC-3, Curtiss C-46 or Convair 240/340 type equipment.**

Cargo Airlines List Salaries With CAB

Washington—Following is a list of all-cargo and Alaska airline officers' and directors' salaries, bonuses, indirect compensations, expenses and stock holdings for the year ending Dec. 31, 1959, as reported to the Civil Aeronautics Board:

AAXICO Airlines, Inc., (carrier did not list expenses)—**H. J. Korth**, president and director, $88,000 salary, no bonus or indirect compensation and 27,358 shares of common stock; **J. G. Helvey**, vice president, general manager and director, $22,200 salary, $11,000 bonus and indirect compensation and no stock; **E. P. Odenwalder**, secretary-treasurer, $12,000 salary, $2,000 bonus and indirect compensation and no stock; **O. F. Stern**, vice president-sales, $12,000 salary, $1,500 bonus and indirect compensation and no stock; **J. A. Young**, vice president-operations, $14,400 salary, $3,500 bonus and indirect compensation and no stock; **W. L. Hanks**, chief pilot, $14,850 salary, $500 bonus and indirect compensation and no stock; **W. J. Korth**, director, no salary, bonus, indirect compensation or stock.

Following firms were paid for services rendered during 1959, **Lear & Scoutt**, legal services, $15,009.92; **Frederick C. Kimball**, aviation consultant, $8,216.77.

Aerovias Sud Americana, Inc.—**L. E. Harmon**, chairman of the board and director (entered office March, 1959, left office September, 1959), no salary, $775 bonus and indirect compensation, $642.68 expenses and no stock; **F. S. Buchanan**, chairman of the board, director and assistant secretary (left office as assistant secretary and entered office as chairman October, 1959), $3,000 salary, $1,225 bonus and indirect compensation, $809.77 expenses, 20,622 shares of common stock, 2,763 shares of common stock in name of others and 100 shares of preferred stock; **V. V. Carmichael, Jr.**, president and general manager and director, $14,531.25 salary, $50 bonus and indirect compensation, $12,159.34 expenses and 10,885 shares of common stock.

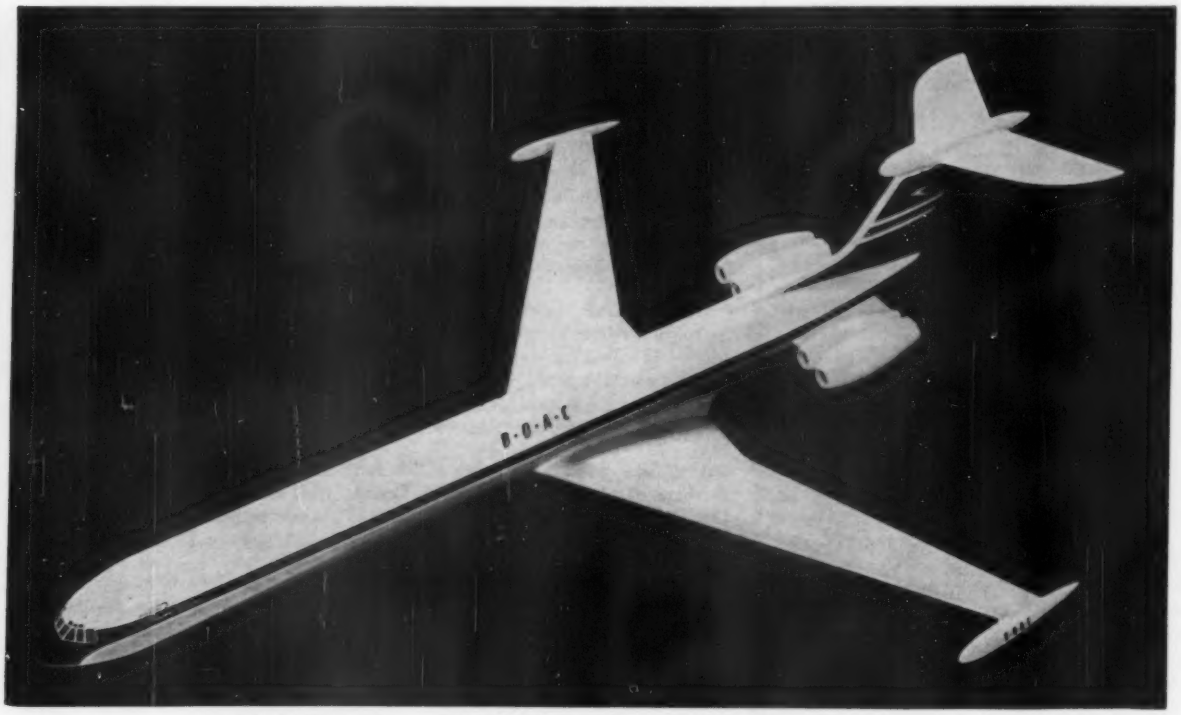
C. B. Powell, vice president and director, $8,606.25 salary, $3,150 bonus and indirect compensation, $2,134.61 expenses and 6,000 shares of common stock, **W. M. Dunn, Jr.**, vice president-traffic and sales, $10,374 salary, no bonus or indirect compensation, $1,988.50 expenses and 900 shares of common stock; **W. M. Bussey**, secretary and director, $1,258.36 salary, $100 bonus and indirect compensation, $211 expenses and no stock; **J. M. Rodrigues**, treasurer, $10,442.25 salary, no bonus or indirect compensation, $26.78 expenses and 100 shares of common stock; **W. C. Chase**, assistant secretary (entered office September, 1959), $6,478.85 salary, no bonus or indirect compensation, $1,867.41 expenses and 500 shares of common stock; **G. W. Sheppard**, assistant treasurer, $7,458.75 salary, no bonus or indirect compensation, $243.48 expenses and 150 shares of common stock.

Following directors were not paid a salary: **M. H. Corson**, $450 bonus and indirect compensation, no expenses or stock; **P. C. Hawkins**, no bonus or indirect compensation or expenses, 3,642 shares of common stock; 500 shares of preferred stock and $2,500 worth of debt securities; **T. E. McLean**, $50 bonus and indirect compensation, no expenses or stock; **G. W. Daniels**, $25 bonus and indirect compensation, no expenses or stock; **F. Freshwater**, $50 bonus and indirect compensation, no expenses, 1,600 shares of common stock and 200 shares of preferred stock; **T. J. Klinedinst**, $25 bonus and indirect compensation, $102.99 expenses and 5,500 shares of common stock; **C. W. Breeman**, $25 bonus and indirect compensation, $112.99 expenses and no stock.

Flying Tiger Line, Inc., (officers were not paid a bonus or indirect compensation, directors were paid director's fees)—**S. B. Mosher**, chairman of the board, no salary, $400 fee, $31 expenses, 29,150 shares of common stock and 818 shares of preferred stock; **R. W. Prescott**, president and director, $51,667 salary, $17,675 expenses and 2,440 shares of common stock; **F. B. Benninger**, executive vice president and treasurer, $30,833 salary, $13,332 expenses and no stock; **W. E. Bartling**, vice president-research, $18,650 salary, $2,910 expenses and five shares of common stock.

G. T. Cussen, regional vice president-San Francisco and Pacific Northwest, $14,000 salary, $5,103 expenses, 10 shares of common stock and 33 shares of preferred stock; **L. S. Kimball**, vice president-public relations, $13,400 salary, $16,893 expenses and 500 shares of common stock; **F. B. Lynott**, vice president-operations, $26,167 salary, $2,359 expenses and 90 shares of common stock in name of others; **N. B. Berboth**, vice president-maintenance, $18,100 salary, $3,251 expenses and no stock; **J. L. Higgins**, vice president-sales, $20,833 salary, $7,995 expenses and no stock; **G. S. Oberdorf**, vice president-assistant to the president, $18,000 salary, $5,461 expenses and no stock.

C. Moldaw, assistant vice president, $11,225 salary, no expenses or stock; **O. R. Burghardt**, secretary and assistant treasurer, $19,100 salary, $176 expenses and no stock; **R. B. Stump**, assistant secretary, $12,900 salary, no expenses or stock; **N. L. Meyers**, assistant secretary and director,



BOAC Orders 10 Vickers Super VC.10 Transports

Model above shows configuration of the Vickers-Armstrongs Super VC.10 jet transport, 10 of which have been ordered by British Overseas Airways Corp. at a cost of about $70 million (AW Feb. 8, p. 39). Transport can carry up to 212 passengers and is 24 ft. longer than standard VC.10 (AW Sept. 21, 1959, p. 38); BOAC has 35 of these on order. Super VC.10 powerplants are four rear-mounted Rolls-Royce Conway 42/2 bypass engines. Takeoff weight has been increased from 299,000 lb. to 347,000 lb. Length is 186 ft. and height is 39 ft. 6 in. Wingspan is 146 ft., with gross area of 2,800 sq. ft. and aspect ratio of 7.

no salary, $400 fee, $92 expenses, 54 shares of common stock and eight shares of preferred stock and $200,000 of debt securities.

Following directors were not paid a salary: **A. T. Chase**, $300 fee, $61 expenses and 1,000 shares of common stock; **H. Rehrig**, $200 fee, no expenses and 110 shares of common stock; **J. C. Cosgrove**, $300 fee, $133 expenses and 551 shares of common stock; **A. G. Linkletter**, $300 fee, $14 expenses and no stock.

C. Luckman, $300 fee, $51 expenses and 1,050 shares of common stock; **J. C. Tyler**, $300 fee, $46 expenses and 505 shares of common stock; **Mrs. R. Axe**, $200 fee, $576 expenses, 420 shares of common stock and 630 shares of common stock in name of others; **B. Gresov**, $400 fee, $1,122 expenses, 25 shares of common stock and $50,000 in company debentures.

Following firms were paid for services rendered during 1959; **Meyers & Batzell**, legal, $134,233; **Hill, Farrer & Burrill**, legal, $39,028; **Arthur Anderson & Co.**, accounting, $21,300; **Hixon & Jorgensen**, advertising, $18,602; **Channing, Wallace & Gibson**, industrial design, $8,687.

Riddle Airlines, Inc., (carrier did not list bonuses or indirect compensation), **R. M. Hewitt**, president and director (entered office 10/10/59), $5,617.97 salary, $3,766 expenses and 100 shares of common stock in name of others; **E. M. Leath, Jr.**, vice president and treasurer (entered office 10/19/59), $11,409.04 salary, $151 expenses and no stock; **C. L. Hood**, vice president-marketing, $14,500 salary, $5,966 expenses and 100 shares of common stock; **R. T. Weaver**, regional vice president-New York, $8,730 salary, $699 expenses and 1,000 shares of common stock.

Mrs. J. B. Love, secretary, $5,000 salary, $26 expenses and 2,700 shares of common stock; **H. B. Donaldson**, assistant to management (entered office 1/12/59), $9,765 salary, $860 expenses and no stock; **J. G. McKay, Jr.**, assistant secretary and director, no salary or expenses, holding 10 shares of common stock in name of others; **R. B. Cole**, director, no salary, or expenses, holding 100 shares of common stock; **W. K. deVeer**, director, no salary or expenses, holding 100 shares of common stock; **W. E. Dunwody, Jr.**, director, no salary or expenses, holding 100 shares of common stock; **C. A. Hinsch**, director, no salary or expenses, holding 43,000 shares of common stock.

Following firms were paid for services rendered during 1959: **Colin McIntosh**, transportation consultant, $9,164; **Robert Hewitt Associates**, financial consultants, $17,130; **Tally Embry**, advertising, $12,286; **Dixon, DeJarnette, Bradford, Williams, McKaye & Kimbrell**, legal, $22,353; **Bowen & Scoutt**, legal, $30,259; **Hunt Aviation**, representation, $8,940; **Price Waterhouse & Co.**, accounting, $16,184; **E. K. Deveer**, financial consultant, $13,775.

Seaboard & Western Airlines, Inc., (carrier did not list bonuses, indirect compensation or expenses)—**B. A. Norden**, president and director, $35,000 salary, 13,126 shares of common stock and 18,187 shares of common stock in name of others; **A. V. Norden**, executive vice president and director, $35,000 salary, 16,027 shares of common stock and 17,143 shares of common stock in name of others; **C. D. Brell**, vice president-operations, $25,000 salary, 24,193 shares of common stock and 6,910 shares of common stock in name of others; **S. I. Fondiller**, treasurer (entered office in 1959), $14,500 salary and no stock; **H. Montee**, vice president-Washington, D. C., $17,500 salary, 10,807 shares of common stock and 2,095 shares of common stock in name of others; **W. P. Neth**, vice president-traffic, secretary and director, $22,500 salary, 17,112 shares of common stock and 7,402 shares of common stock in name of others.

W. H. Renninger, vice president-engineering, $18,000 salary and 3,808 shares of common stock; **J. H. Rosenwald**, vice president-administration, $13,500 salary and 50,979 shares of common stock; **A. Thompson**, vice president-commercial services, $15,000 salary and 312 shares of common stock; **J. H. Mahoney**, industrial and government affairs (resigned September, 1959), $11,365.38 salary and no stock; **E. O. Schroeder**, vice president-maintenance (resigned April, 1959), $6,538.02 salary and no stock.

D. M. Amman, director, $4,200 salary and 5,726 shares of common stock; **C. B. Ripley**, director, no salary, 17,962 shares of common stock and 8,000 shares of common stock in name of others; **F. Vahlsing**, director, no salary and 81,200 shares of common stock.

Following firms were paid for services rendered during 1959; **Mel Adams & Associates**, public relations counsel, $37,726.15; **Lowenstein, Pitcher, Spence, Hotchkiss, Amman & Parr**, legal counsel, $52,357.41; **Hardy Maclay**, legal, $61,884.79; **Joel Fisher**, legal, $11,982.45; **Robert Johnson**, legal, $40,596.20; **Irving Raines**, legal, $5,200.55; **William Kridel**, legal, $6,533.21; **Arthur Young & Co.**, auditing, $27,000; **Hagard Advertising**, advertising, $22,871.82; **William T. Arthur**, aviation consultant, $6,243.08; **Thor Solberg**, aviation consultant, $13,333.33; **Stanley Brewer**, economic consultant, $7,865.75.

Pacific Northern Airlines, Inc.—**A. G. Woodley**, president and director, $35,000 salary, $400 fee, $4,522 expenses and 230,377 shares of common stock; **J. A. Cunningham**, vice president and director, $18,081.25 salary, $400 fee, $203 expenses and 1,500 shares of common stock; **H. A. Olsen**, vice president, $15,911.50 salary, no fee, $1,155 expenses and 8,200 shares of common stock; **J. H. Foster**, vice president, $15,911.50 salary, no fee, $276 expenses and 1,000 shares of common stock; **F. Aubuchon**, vice president, $13,150 salary, no fee, $34 expenses and 4,100 shares of common stock; **T. D. Stuart**, vice president, $13,150 salary, no fee, $384 expenses and 1,700 shares of common stock.

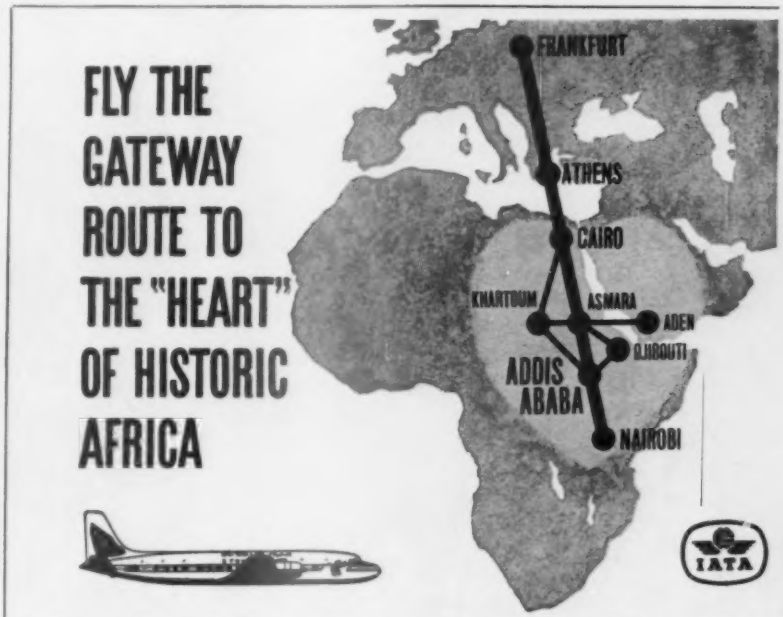
C. W. Nelson, secretary-treasurer and director, $14,465 salary, $400 fee, $59 expenses and 500 shares of common stock; **M. E. Diamond**, assistant secretary, $9,205 salary, no fee, $49 expenses and 27,713 shares of common stock; **D. B. Hart**, assistant secretary, $10,631.77 salary, no fee, $165 expenses, 2,520 shares of common stock and 3,980 shares of common stock in name of others; **G. P. O'Grady**, director, no salary, $200 fee, $2,829 expenses and 3,001 shares of common stock; **R. A. Rowan**, director, no salary, $100 fee, $175 expenses and 16,000 shares of common stock; **H. B. Kirkpatrick**, director, no salary, $400 fee, no expenses and 3,051 shares of common stock; **P. Porzelt**, director, no salary, fee or expenses, holding 100 shares of common stock.

O'Grady & Marshall, legal counsel, was paid $25,812 for services rendered during 1959.

Wien Alaska Airlines, Inc., (carrier did not list bonus or indirect compensation)—**S. Wien**, president, general manager and chairman of the board, $23,000.04 salary, $835.79 expenses and 5,484 shares of common stock; **G. B. Rayburn**, executive vice president and treasurer, $21,802.04 salary, $1,441.60 expenses and 1,083 shares of common stock; **F. Wien**, vice president and director, $19,550.04 salary, $538.32 expenses and 1,079 shares of common stock; **N. Wien**, vice president and director, $18,975 salary, $1,776.14 expenses and 1,088 shares of common stock.

A. E. Hagberg, vice president, $19,478.13 salary, $1,448.82 expenses and 88 shares of common stock; **R. M. King**, secretary, $20,010 salary, $1,263.90 expenses and 101 shares of common stock; **R. B. Webb**, assistant secretary, no salary or expenses, 52 shares of common stock; **M. Barnes**, assistant secretary, $1,752.94 salary, no expenses or stock; **M. Whitney**, assistant secretary, no salary or expenses, 25 shares of common stock; **B. Stahell**, (entered office 6/24/59), assistant secretary, $3,566.51 salary, $120.76 expenses and no stock; **C. J. Clashy**, director, no salary or expenses, 104 shares of common stock; **A. Polet**, director, no salary or expenses, 184 shares of common stock; **B. Balchen**, director, (entered office 12/12/59), no salary, expenses or stock.

Following firms were paid for services rendered during 1959: **Collins & Clasby**, legal, $6,357.63; **Air Transport Assn.**, airline industry liaison, $5,240.69; **Robert T. Lamson**, aviation consultant, $5,730.09; **Theodore I. Seamon**, legal, $12,497.15; **Bosworth-Sullivan**, arrangement for Fairchild F-27 financing, $30,000.



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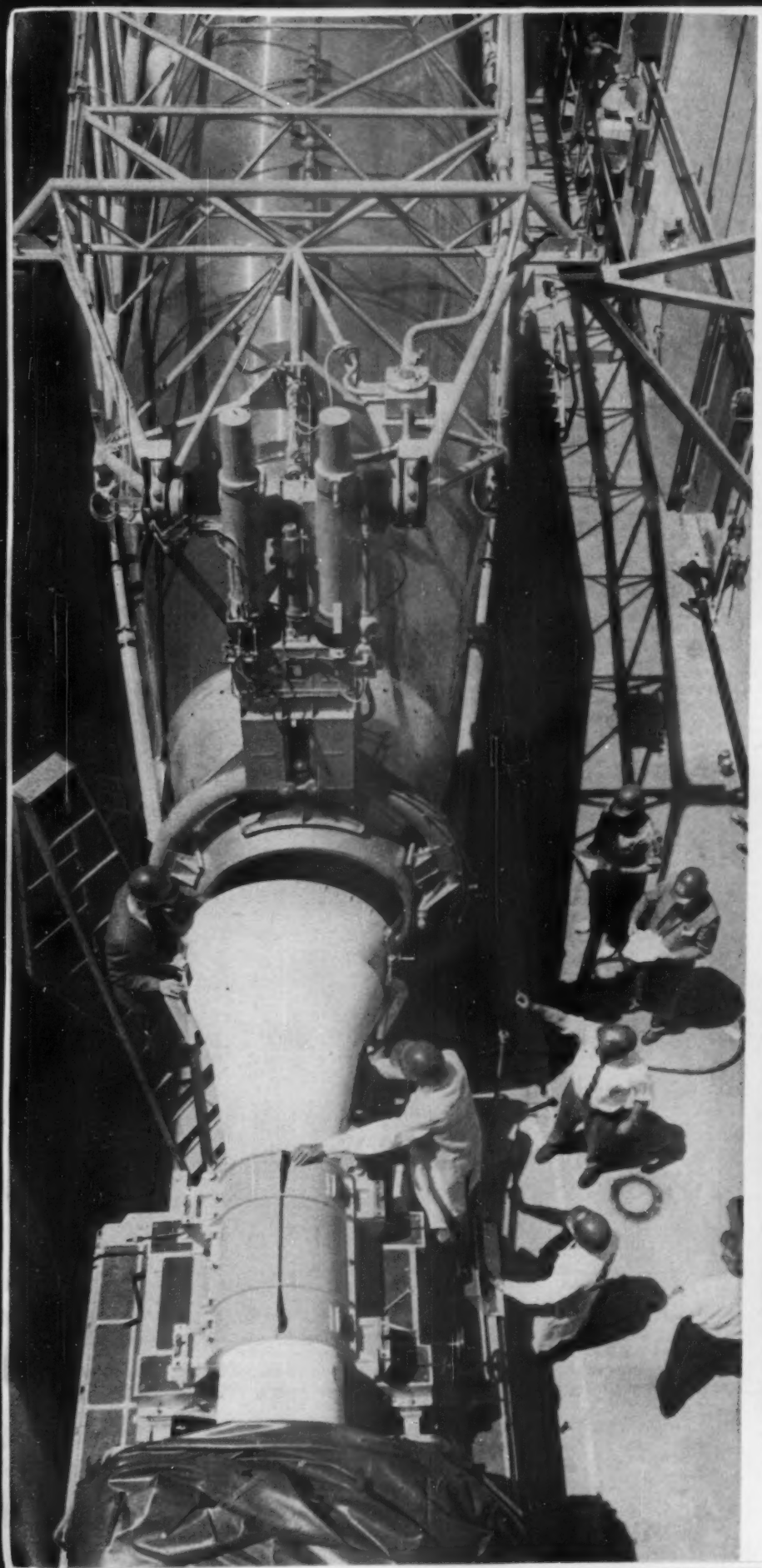
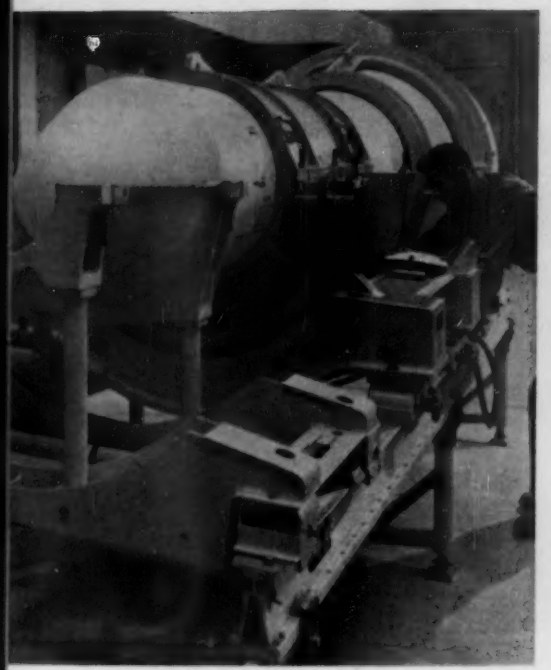
THE WONDERLAND ROUTE

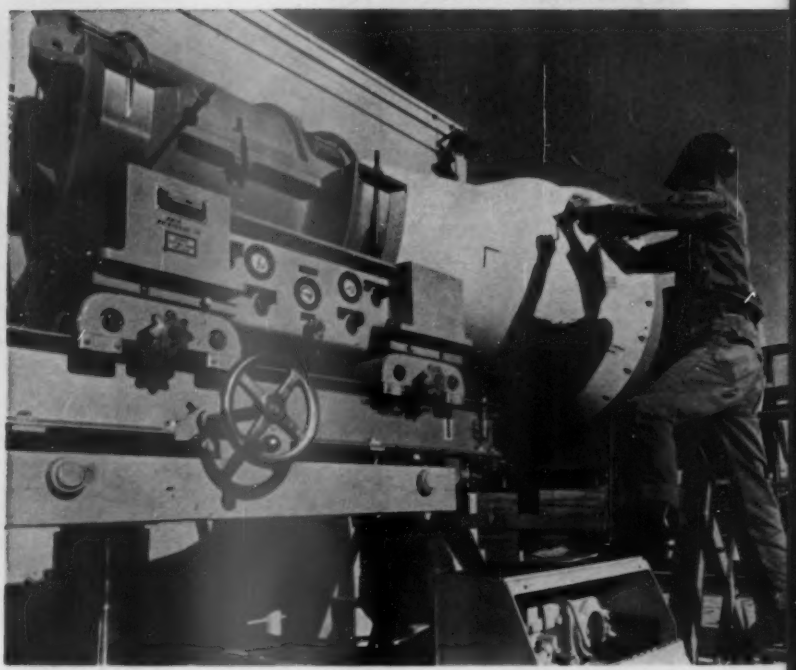


Re-entry vehicle gets arming, fuzing, separation circuit check in Surveillance and Inspection Building (above).

Lift Trailer

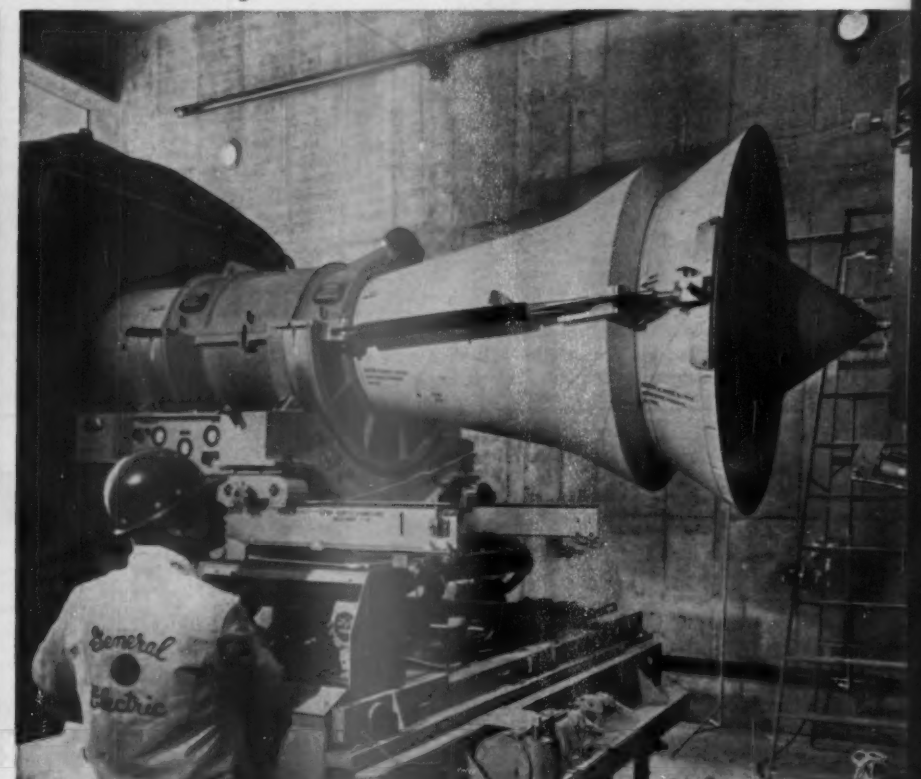
GE technicians (left) position re-entry vehicle laterally for mating to Atlas at Warren AFB "coffin" site.



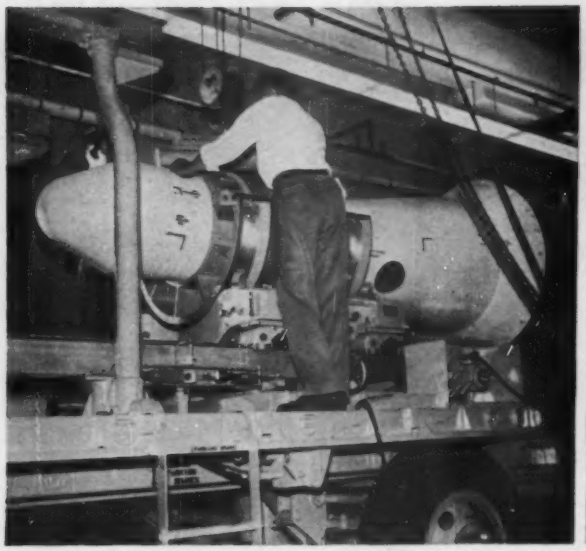


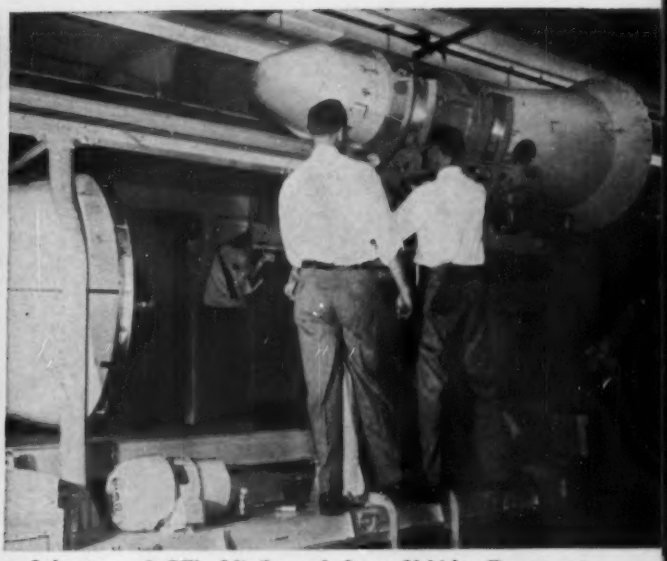
Re-entry vehicle (right, above) is mated to dummy missile in training exercise. Centerline of Atlas is 100 in. from floor. Lift vehicle puts nose cone into approximate position. Then air bags on carriage containing nose cone are inflated so that 25 lb. of manual pressure will position cone precisely. Bags are standard truck air suspension bags adapted for this purpose.

Used in Mating GE Re-Entry Vehicle to Convair Atlas

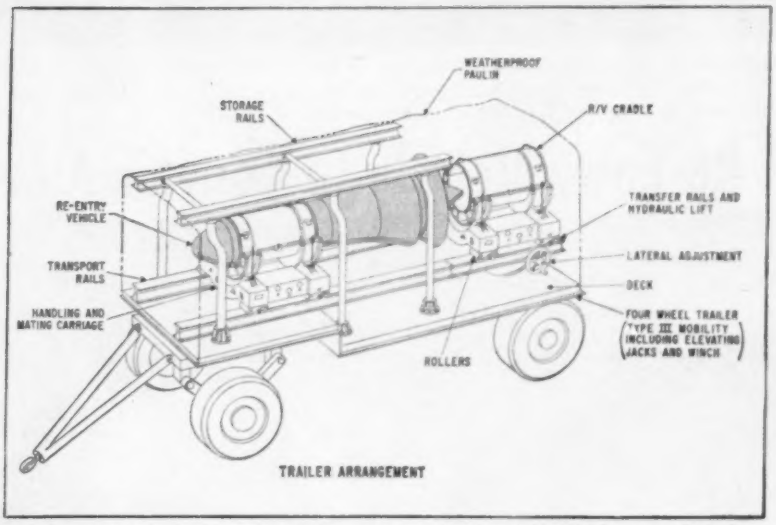


Carriage of lift vehicle, resting on its air bags, is moved slightly to position cone against dummy missile (left, above). This training is done at Surveillance and Inspection Building at main site. Actual mating of cones to missiles is done at launching sites (right, above). Mark 3, Mod. 2 re-entry vehicle features biconic flare at tail, spacer between cone and missile.



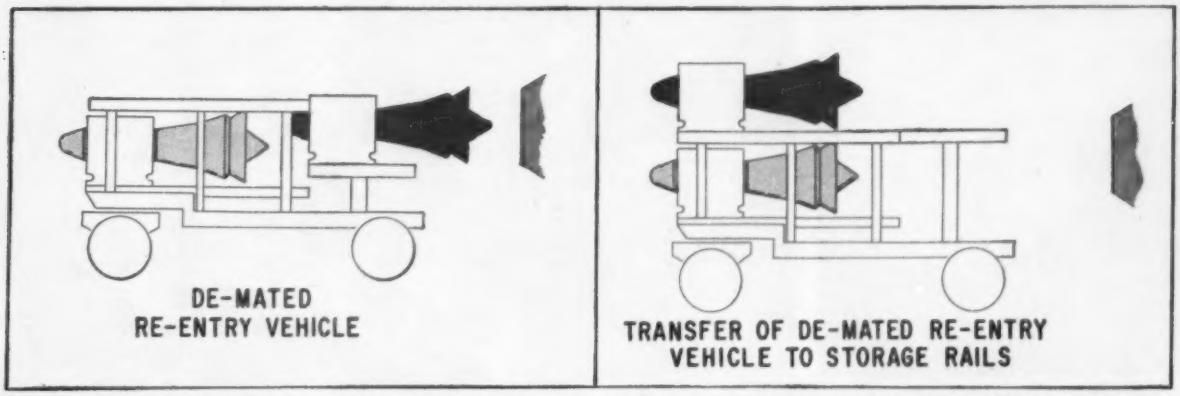


Re-entry vehicle trailer is checked out at Mechanical Equipment Laboratory of GE's Missiles and Space Vehicles Department, which developed it. GE Mark 3 cone rests in center section cradle on movable carriage (left). Carriage can be raised and cradle stored on top rails after de-mating. New cone (right) on bottom rails can then be placed on missile. Bottom cone is dummy Avco Mark 4.



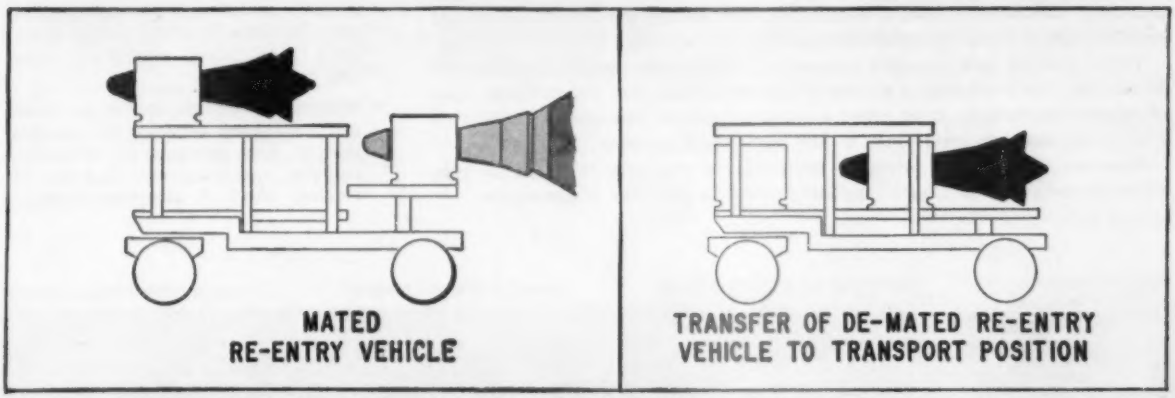
Re-entry vehicle transportation and lift trailer was developed by GE from standard Army cargo trailer bed and is certified for USAF Type 3 mobility, which means it will carry nose cone over highways at 50 mph. without imparting detrimental loads to cone.

Development of ablation-type General Electric Mark 3 nose cone for the USAF-Convair Atlas intercontinental missile began in October, 1958. First research and development firing took place Oct. 6, 1959. Re-entry vehicle transportation and lift trailer was developed in even shorter time as part of ground support equipment, which includes all equipment necessary for receipt, assembly, checkout, transportation and monitoring of the re-entry vehicle. Same equipment is used in training Strategic Air Command crewmen, who take over nose cone mating task after GE has performed installation and checkout functions and integrated weapon system training is completed. This trailer will be used for Atlas squadrons using either GE or Avco nose cones. Since cones for USAF-Martin Titan are mated while missile is in vertical position, Avco-developed trailer vehicle for Titan cones has different traits, does not require elevator carriage.



Nose cone is removed from missile and locked into cradle for storage on top rails. Operation is necessary if monitoring equipment at launching site shows internal systems are not functioning properly. Trailer returns cone to main site for modification.

GE cone rests in cradle on top rails. Carriage has picked up cradle-carrying Avco cone and will lift it to dummy Atlas. Center section cradle for smaller-diameter GE cone (arrow) is built up by webbing. Higher yield Avco cone eventually will replace GE cone.



New nose cone is picked up by carriage and elevated to mating position (left). Old cone is then transferred from upper rails to lower part of trailer for transportation to Receipt, Inspection and Maintenance site for more complete checkout and whatever modification is needed.

HOW TO TURN A MESS.....

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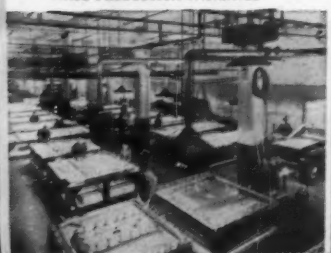

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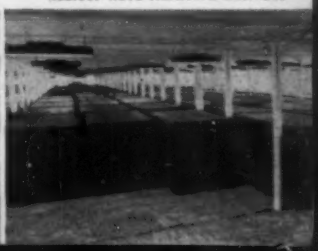
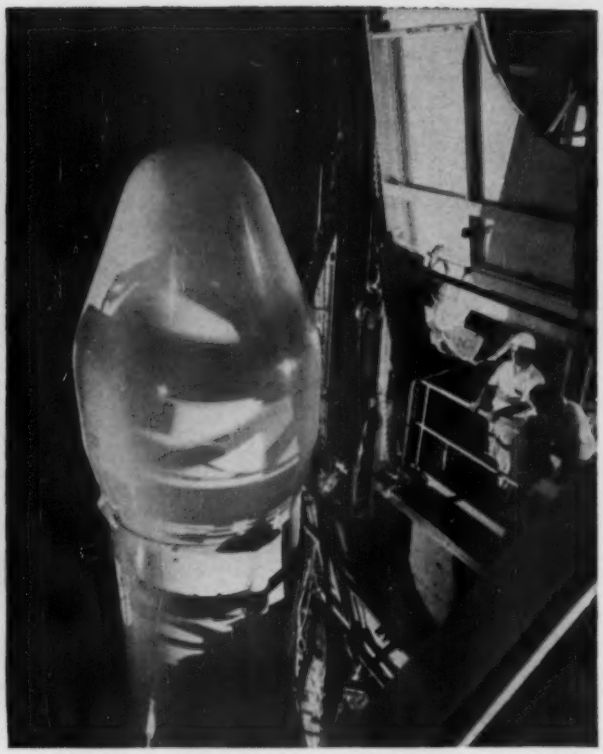
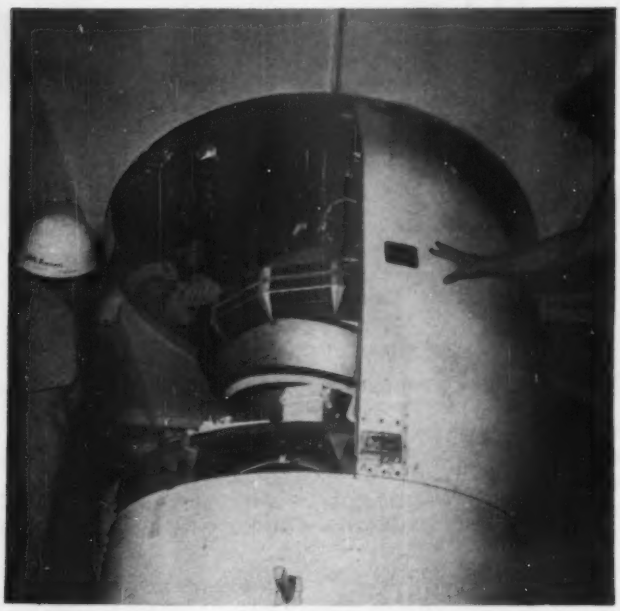




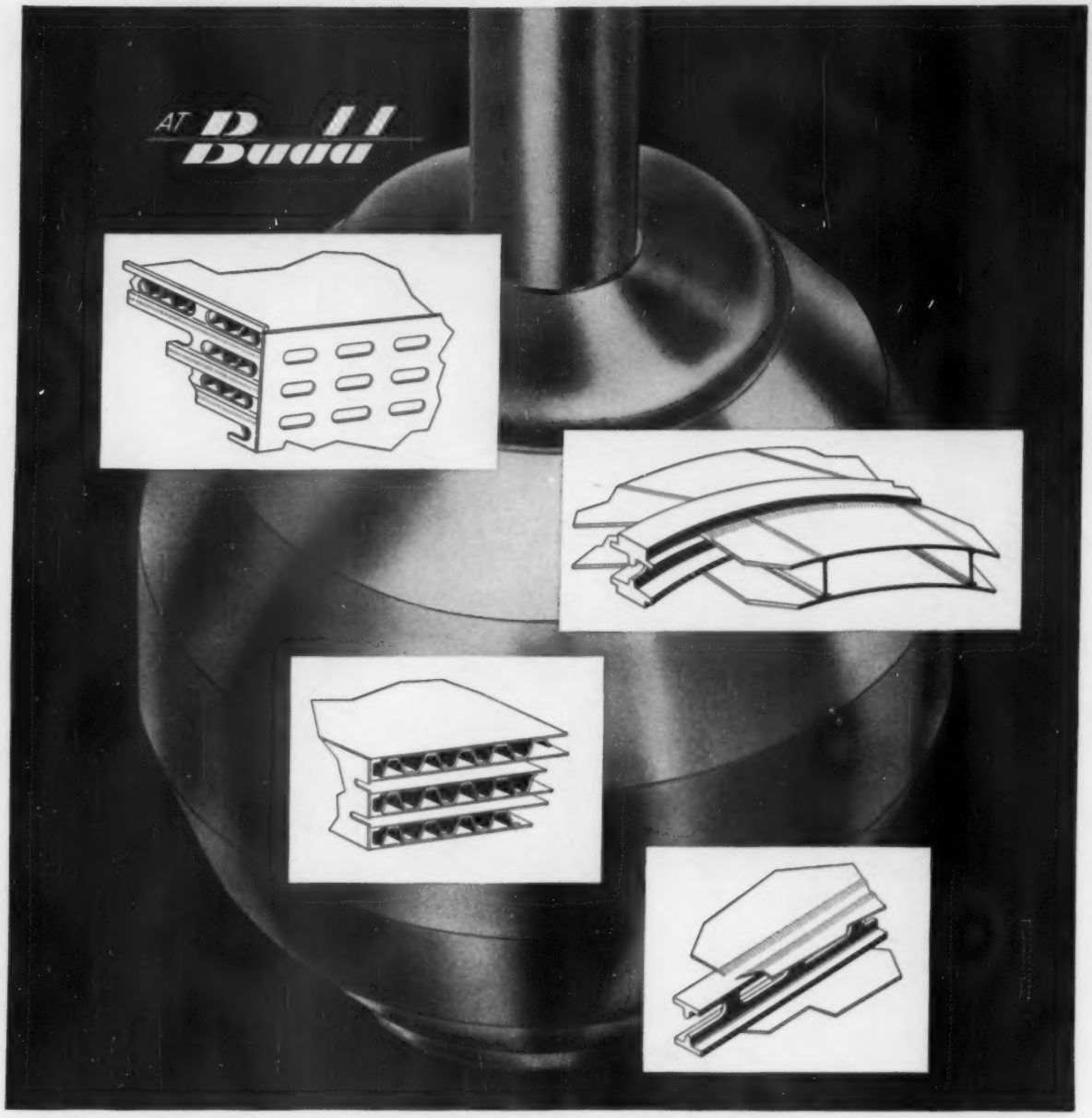
Liquid oxygen tank in Thor booster for two-stage Able Star vehicle is topped off (left) just prior to launching of Transit II-A navigation satellite (AW June 27, p. 26). The basic Thor was slightly modified to allow mating with Aerojet Able Star engine. At right, work platforms are swung back to clear the payload and vehicle just before the gantry is backed away from the pad.

Transit II-A Launched From Cape Canaveral



Final adjustments are made to Transit II-A (left) from the work platform; jettisonable nose fairing was secured by six quick release fasteners which were used to secure the two sides of the fairing together. Solar cell energy sources on the Transit II-A satellite are located in a band around its circumference (right); on the smaller satellite installed above for radiation measurement, the cells are placed in circular ports. Antenna on Transit II-A is the white spiral band painted on its surface. The radiation measurement satellite uses whip-type antennas. The two satellites are held together by a single clamp. As the satellites were separated from the final rocket stage, the clamp was blown free by two explosive fasteners, and a compressed spring pushed them apart.

Liquid oxygen partially envelops USAF Thor-Able Star vehicle at launch. Steam in the background is from the exhaust deflector pit. Able Star second stage engine is the first rocket engine known to have been stopped and restarted in space. Restart has been successful on both flights on which it was attempted—the launchings of Transit satellites I-B and II-A.



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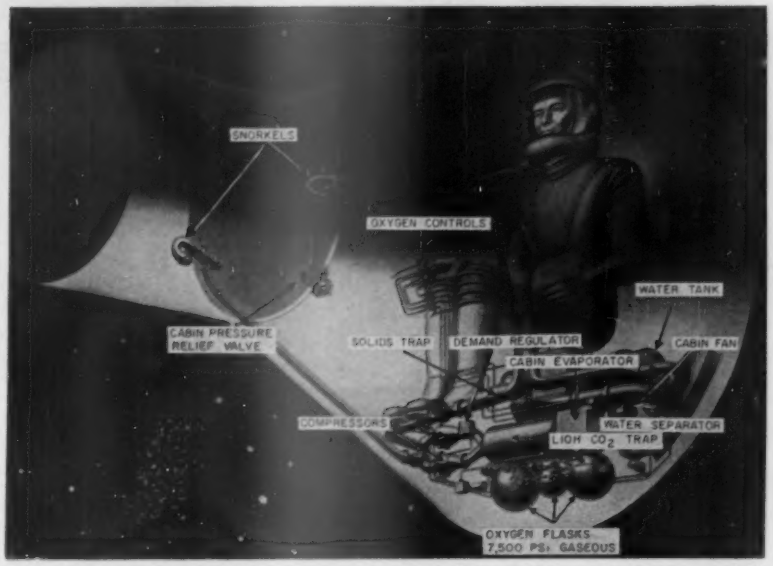
SPACEATOMICS Budd DIVISION

System Controls Capsule Environment

By William S. Reed

Los Angeles, Calif.—Environmental control system for Project Mercury space capsules weighing 85 lb. will provide a temperature-pressure-humidity controlled atmosphere for orbital flight. System redundancy, plus manually-operated override controls, ensures the maximum in occupant safety.

Developed by AiResearch Division of the Garrett Corp. under subcontract to McDonnell Aircraft Corp., the components have been tested and qualified and units now are being fabricated by AiResearch for shipment to McDonnell at St. Louis, Mo.



OXYGEN is stored under high pressure in three flasks located beneath the space pilot's seat. Controls are at his right hand and compressors are fitted under his feet.

Livable Environment

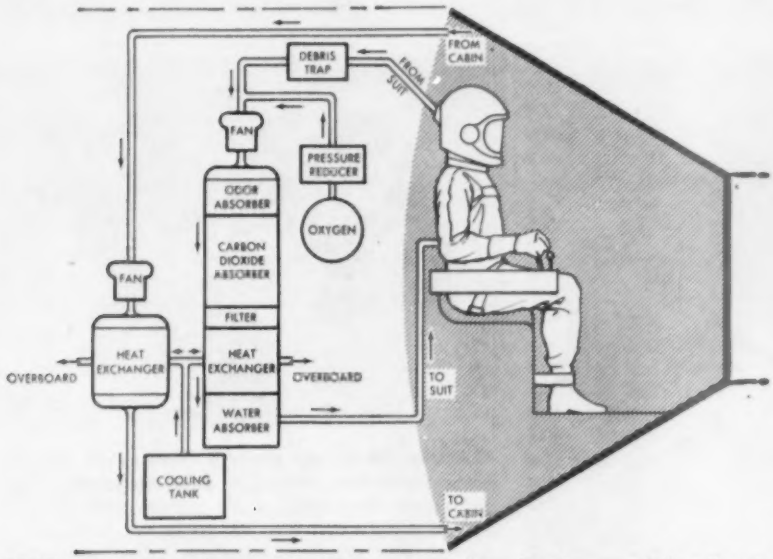
The environmental control system provides a livable environment for the capsule pilot by controlling gaseous composition, temperature and pressure, and also provides cooling for the electronic equipment aboard the capsule. The system is designed to the following specific requirements:

- **Metabolic oxygen** pressurization and ventilation in both pressure suit and cabin must be provided for a minimum of 28 flight hours.
- **Cabin temperature** must be selectable and automatically maintained between 50 and 80F in the orbital phase with a maximum of 200F at launch and re-entry.
- **Carbon dioxide and water pressure** produced by the space pilot must be removed from the environment.
- **Humidity/temperatures combinations** must be maintained at a comfortable level in the pressure suit during all phases of flight.
- **Operation must be maintained** during weightless and high accelerative conditions.

Capsule Pressure

Pressure within the capsule is maintained at 5 psi. in an all-oxygen atmosphere. The space pilot's full-pressure suit serves as a backup to the cabin pressurization system and provides ventilation. Environmental conditions within both the suit and capsule are automatically controlled during all phases of flight. Manual controls are provided to enable system operation to be performed by the space pilot in the event of automatic control failure. Both the cabin system and the pressure suit system operate simultaneously and are supplied from common oxygen, water and electrical supplies.

Oxygen is stored in two spherical 7,500 psi. containers each holding 4 lb. of oxygen. One container is sufficient for 26 hr., assuming consumption rates of 500 cc. per minute and a cabin leakage rate of 300 cc. per minute. Both containers are equipped with pressure reducers which bring the primary 7,500 psi. pressure down to 100 psi. pressure. Upon depletion of the primary supply, the emergency supply, set to operate at 80 psi., automatically is actuated.



SCHEMATIC drawing shows routing of gases to and from the Mercury pilot's suit; note outlet fitting at back of his helmet. Heat exchanger includes vent for dumping.

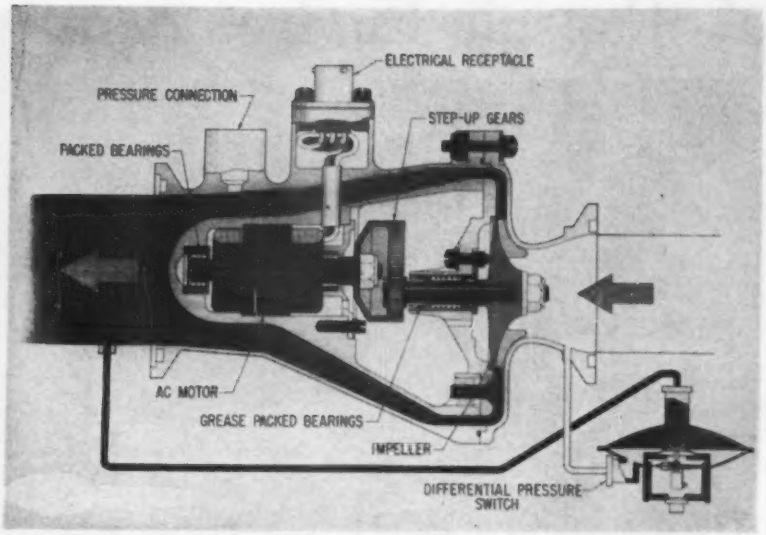
Rubber Bladder

Water for the evaporative-type heat exchangers is carried in a tank fitted with a rubber bladder for weightless operation. Tank capacity is 35 lb. of water.

Oxygen is admitted to one side of the bladder membrane to force water from the tank into the heat exchangers. Water flow into the heat exchangers is metered through a control valve.

Electrical power required by the environment system is 115 v., 400 cycle a.c. current to drive system motors, plus 28 v. d.c. current for operating solenoid valves and system instruments.

The pressure suit is coupled into the



CIRCUIT compressor for the space pilot's suit is detailed in the above drawing.

system by an inlet connection at the suit torso and an exit connection at the helmet. Pure oxygen is forced into the suit to provide pressurization and a breathable atmosphere. In the course of the space pilot's respiration and other body activity, the oxygen gas stream will pick up carbon dioxide, water vapor and body odors. As the gas stream emerges from the helmet exit port, it is first passed through a solids trap where it will be cleansed of dirt, lint or other particulate matter.

Odor Removal

The gas next is passed through one pound of activated charcoal for odor removal and then through two chambers, each containing 2.6 lb. of lithium hydroxide (LiOH) where the carbon dioxide content is absorbed. Under normal conditions, an individual will expel approximately 2.6 lb. of carbon dioxide in a 24 hr. period. The LiOH is in two separate containers for more effective utilization and is filtered at the exit port to prevent lithium hydroxide dust from entering the system.

Next stage of the process is to pass the gas over a heat exchanger where it is cooled to approximately 45F. During the cooling process, water vapor in the gas condenses into droplets and is carried suspended in the gas stream into a water separator. The water is collected in a sponge and is squeezed by an oxygen-actuated piston once every 30 min. The water collected will be available for drinking during the post-flight period. Approximately 6 lb. of water will be collected during a normal 24-hr. mission. The cooled, filtered, purified oxygen then is pumped back into the torso connection at the suit where the process is repeated.

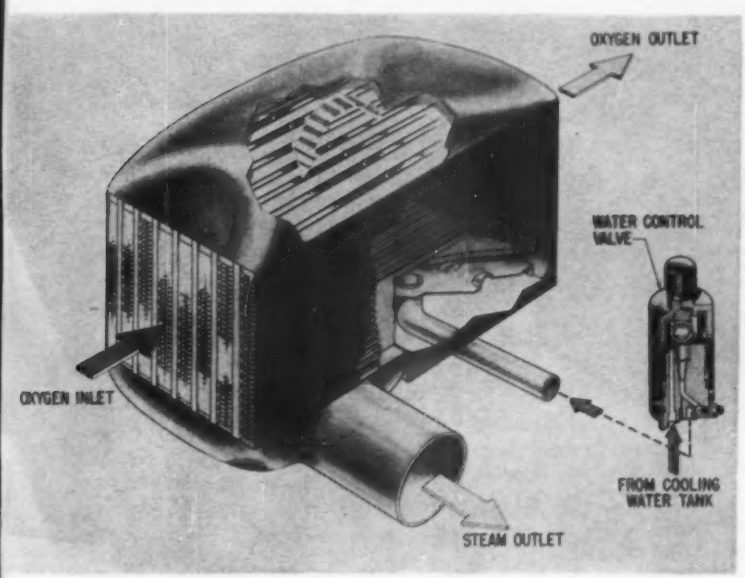
Two centrifugal type compressors are used in the suit system. They develop a flow of 10 cu. ft. per min. with a pressure head of 10 in. of water. Should one blower fail, a pressure switch senses the loss of pressure across the blower and automatically actuates the second blower.

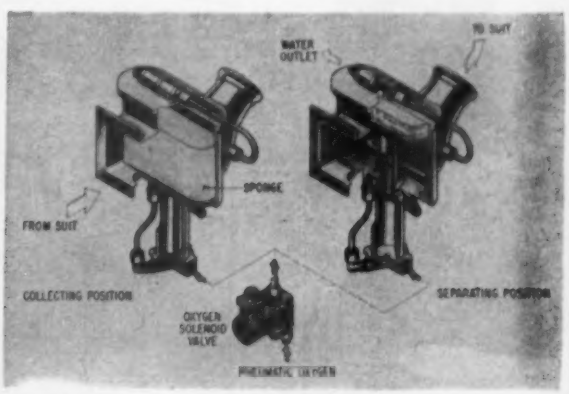
Heat Exchanger

Heat exchanger in the pressure suit system is rated at 1,000 Btu. per hr. Water is fed from the coolant water tank onto a fiber pad and into capillary-like tubes in the heat exchanger. The water removes heat from the gas stream and then evaporates. The water vapors then make a second pass through the heat exchanger where heat is removed from the inlet gas, superheating the water vapors. Purpose of the second pass is to superheat the water vapors before they are dumped overboard to prevent icing in the vent line. A temperature switch on the overboard vent line is set to actuate when water vapor temperature drops below 50F. The space pilot will then be afforded visual indication of excessive water flow into the heat exchanger and the flow can then be regulated.

Since little cooling will be afforded by the evaporative system at sea level, prelaunch cooling is provided through the heat exchanger by passing Freon 114 through the capsule umbilical connection into the water side of the heat exchanger.

Oxygen and water are provided for the cabin control system from tanks common with the pressure suit system. A pressure relief valve in the cabin allows pressure to follow ambient up to





EVAPORATOR for zero gravity is shown at left, with the water control valve enlarged to show components. Schematic above shows details of the capsule's water separator with inlet and outlet from the pilot's suit designated by arrows. The evaporator maintains cabin temperature; cooled oxygen (45F) also is directed into the avionic bay for equipment cooling.

27,000 ft. altitude after launch where the valve seals the cabin at 5.5 psi. A manual control handle for depressurization is located on the instrument console to provide a means of dumping cabin pressure in the event of fire or buildup of toxic gases.

A launch oxygen system is provided to furnish an oxygen-enriched cabin atmosphere. One pound of oxygen under 7,500 psi. is stored in a spherical container to be metered into the cabin between 10,000 and 27,000 ft. As the capsule passes 10,000 ft., a barometrically-controlled valve opens, discharging oxygen into the cabin. The purge operation ensures a minimum cabin oxygen partial pressure of 3.8 psi. A visual indication is afforded the space pilot by a light on the sequence panel. Manual backup is provided on the console to ensure operation of the launch oxygen supply.

Oxygen Regulator

Cabin pressure automatically is maintained at 5.1 psi. by a regulator which meters pure oxygen into the cabin. Loss of oxygen is prevented by a valve designed to close if the cabin pressure falls to 4.0 psi., such as would happen in the event of a puncture in the cabin wall. Overboard dumping of oxygen is thereby prevented and the oxygen supply retained for use in the pressure suit. A manual recompress feature is incorporated which allows the space pilot to repressurize the cabin if it can be determined that decompression was of a temporary nature.

Cabin temperature is maintained by an evaporator similar to that used for the pressure suit. Cooled oxygen at approximately 45F is directed into the avionic bay for equipment cooling.

As the capsule passes 20,000 ft. following re-entry, snorkel inlet and outflow valves open automatically by barometric control for post-landing cabin ventilation. Simultaneously with the opening of the snorkel valves, a shut-off valve in the pressure suit control system is closed and the emergency rate valve opened. Ambient air then is drawn in through the snorkel valve by the suit compressor, is enriched with oxygen and then is forced through the pressure suit where it exits into the cabin through the exhaust port of the pressure suit regulator. The snorkel outflow valve then permits the air to exit from the cabin. A manual backup system is provided for snorkel valve operation in the event of barometric valve failure.

Environmental control system instrumentation is grouped in the upper right hand corner of the instrument panel. Instrumentation, not a part of AiResearch's contract, provides indications of the following parameters: cabin pressure, temperature, relative humidity and oxygen partial pressure; primary and emergency oxygen supply pressure; and carbon dioxide partial pressure downstream of the lithium hydroxide canister in the pressure suit control system. Cabin and suit pressure system fan controls also are provided on this panel. A warning light panel is installed adjacent to the environmental control system instrumentation. Auditory warning signals also are actuated when failures occur. In addition, warning lights are provided for loss in cabin pressurization, depletion of primary oxygen supply, emergency rate mode of operation, decrease in cabin oxygen partial pressure below 3 psi., increase of carbon dioxide partial pressure to 3% in the pressure suit and excessive cooling water to the suit and cabin heat exchangers.

System controls are located on the left console for cabin decompression and repressurization. A warning light panel is located on the left console to give indication of flight event sequential operation.

Physiological Data

Continued physiological data on the space pilot's condition in flight will be made with electrocardiograph, body temperature, and respiration rate and depth measurements. This data will be recorded by on-board recorders and will be telemetered.

During orbital flight, since the cabin will be maintained at the same pure oxygen content of 5 psi. as will be the suit, faceplate on the pressure suit may be opened at any time. Only objection

Boeing Tests Vibrations for Navy

Detailed experiments to determine the effects of low-frequency vibrations on human performance are being undertaken by Boeing Airplane Co.'s Wichita, Kan., Division for the Office of Naval Research. The specially designed Boeing vibrator, operated here by test pilot Richard Thomas, is actuated by a hydraulic cylinder and frequency can be regulated from one to 30 times per second with varying forces. Initially, subjects will attempt no tasks other than to relate opinions on effect of vibrations; later they will be given specific tasks to perform and accomplishments will be measured against earlier opinions. Subjects will be instrumented.

to so doing will be the possibility of sudden cabin decompression caused by collision with a meteor. As more information about the size and frequency of meteor contacts is learned, advisability of opening the faceplate may be established. It undoubtedly will be necessary to open the faceplate during a 24-hr. orbit in order for the space pilot to eat and drink. Even though cabin pressure fails, the pilot can survive in the pressure suit, but if rapid decompression occurs with the faceplate open, it is problematical as to whether or not he may get the faceplate closed in time to prevent death from decompression.

Cold soak of the cabin and pressure suit will be accomplished manually by the pilot at a predetermined time prior to re-entry. This is accomplished by opening the heat exchanger water control valve to allow maximum water flow into the heat exchanger. The heat buildup lag during re-entry is sufficient to prevent the interior of the capsule from becoming prohibitively warm until the snorkel system can provide sufficient ambient air for breathing and ventilation.

The environmental control system will be used on all flights of the Mercury capsule. A manned simulator will be installed in the capsule to load the environmental control system on all non-biological flights. Primates will be supported by the system in the animal phase of the project.

LOCKING rings for Argo D-8 Journeyman rocket are inspected by Aerolab's Paul Yazaki.

Argo Rockets to Explore Radiation

Pasadena, Calif.—Research flights will be conducted from Pt. Arguello this fall by Aerolab Development Co., subsidiary of Ryan Aeronautical Co., to probe the Van Allen radiation belt to gather basic data leading to protection of crews from radiation hazards. Project is part of National Aeronautics and Space Administration's NERV (Nuclear Emulsion Radiation Vehicle) program.

Aerolab has assembled the four-stage solid-propellant Argo D-8 Journeyman rockets to boost a 125-lb. General Electric instrumentation payload to 1,200 mi. altitude over a 1,700-mi. course in the research program. The Argo D-8 boost vehicle consists of a three-motor first stage cluster of a Sergeant and two auxiliary Recruit rockets, second and third stages of Lance rockets, and a fourth stage of an Allegany Ballistic Laboratory X-248 rocket.

Vehicle trajectory will be south from Pt. Arguello along one of the lines of force of the earth's magnetic field.

The NERV experiment contains a cylindrical disk of nuclear emulsion ½-in. thick and 3 in. in diameter, which will be fully extended from the nose cone at approximately 150 mi. altitude during the vehicle ascent.

The emulsion will continue to be exposed until the NERV vehicle is within 200 mi. of the point of descent. At 120-mi. altitude the emulsion package will be telescoped forward out of the tip of the nose cone. On re-entry, an extended skirt-type parachute will be deployed at 40,000 ft. to slow the nose cone to a descent of 50 fps. when it hits the water.

The level and type of radiation encountered will be determined by examination of tracks in the emulsion made by radiation particles. Since information on the emulsion cannot be telemetered from the vehicle, it will be necessary to recover the NERV payload to get flight results.

Prompt recovery of the buoyant nose cone payload, containing the instrumentation will be attempted by parachute and pickup by Navy ships. Aerolab engineers must plot precisely the ballistic trajectory and impact point in order to recover the payload.

Aerolab and GE are prime contractors to NASA, which produces the cone-shaped nuclear emulsion package.

Transit Data Confirms Earth Is Pear-Shaped

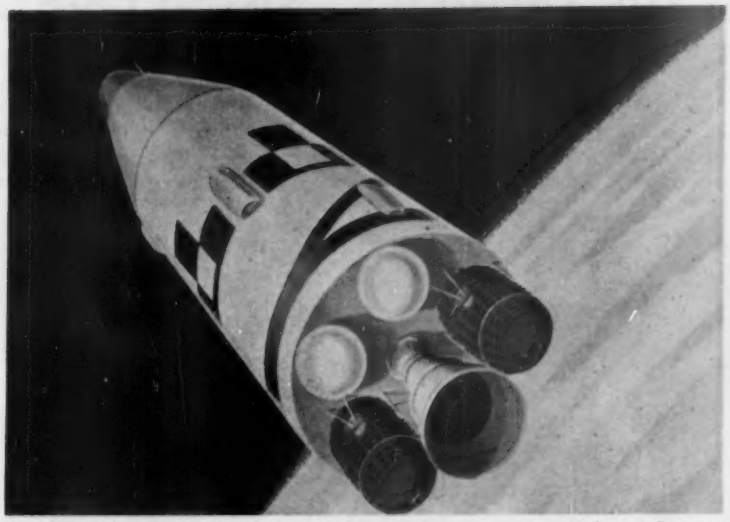
Washington—Detailed study of the orbit of Navy's Transit I-B has confirmed earlier findings, based on Vanguard I's orbit, that the earth is slightly pear-shaped.

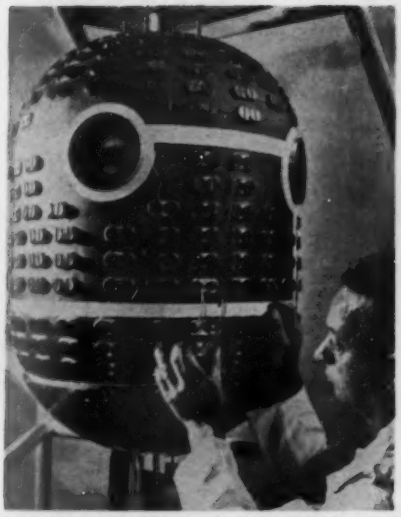
The independent confirmation was made by Dr. C. J. Cohen and R. J. Anderle of the Naval Weapons Laboratory at Dahlgren, Va. It is significant because Transit's orbit has a different height, eccentricity and inclination than Vanguard, and because Cohen and Anderle used basically different methods of orbit observation and data reduction than Dr. John A. O'Keefe of National Aeronautics and Space Administration did in the Vanguard.

Asymmetry of the gravitational field between the northern and southern hemispheres results because the north pole is displaced some 50 ft. away from the equatorial plane, and the south pole is displaced about the same distance toward the equator. This affects the entire orbit of a satellite and has reduced the perigee of Transit I-B at the rate of about 0.2 mi. per day.

The laboratory's studies have greatly improved orbital prediction capability, Navy said. Some improvement resulted from reduction of the predicted atmospheric drag by about 30%. Goal is an improvement to the point that orbits can be predicted ahead for at least one-half day to the same high accuracy, so that satellites can be useful in an operational navigation system.

Cohen and Anderle compared Doppler signals from Transit I-B with results of numerical integration of its equations of motion obtained by a computator and established the orbit with enough accuracy that the effect of the asymmetry in the gravitational field was noticeable.

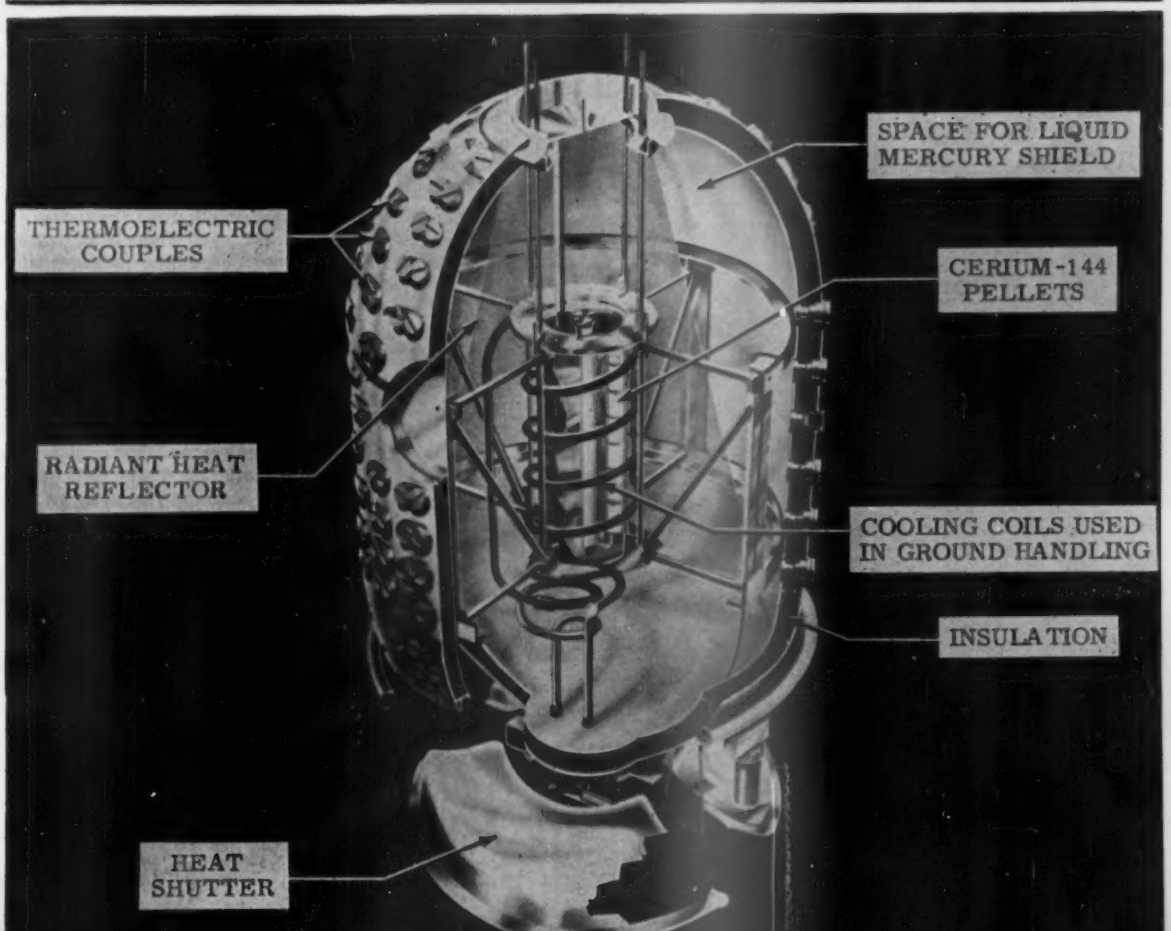




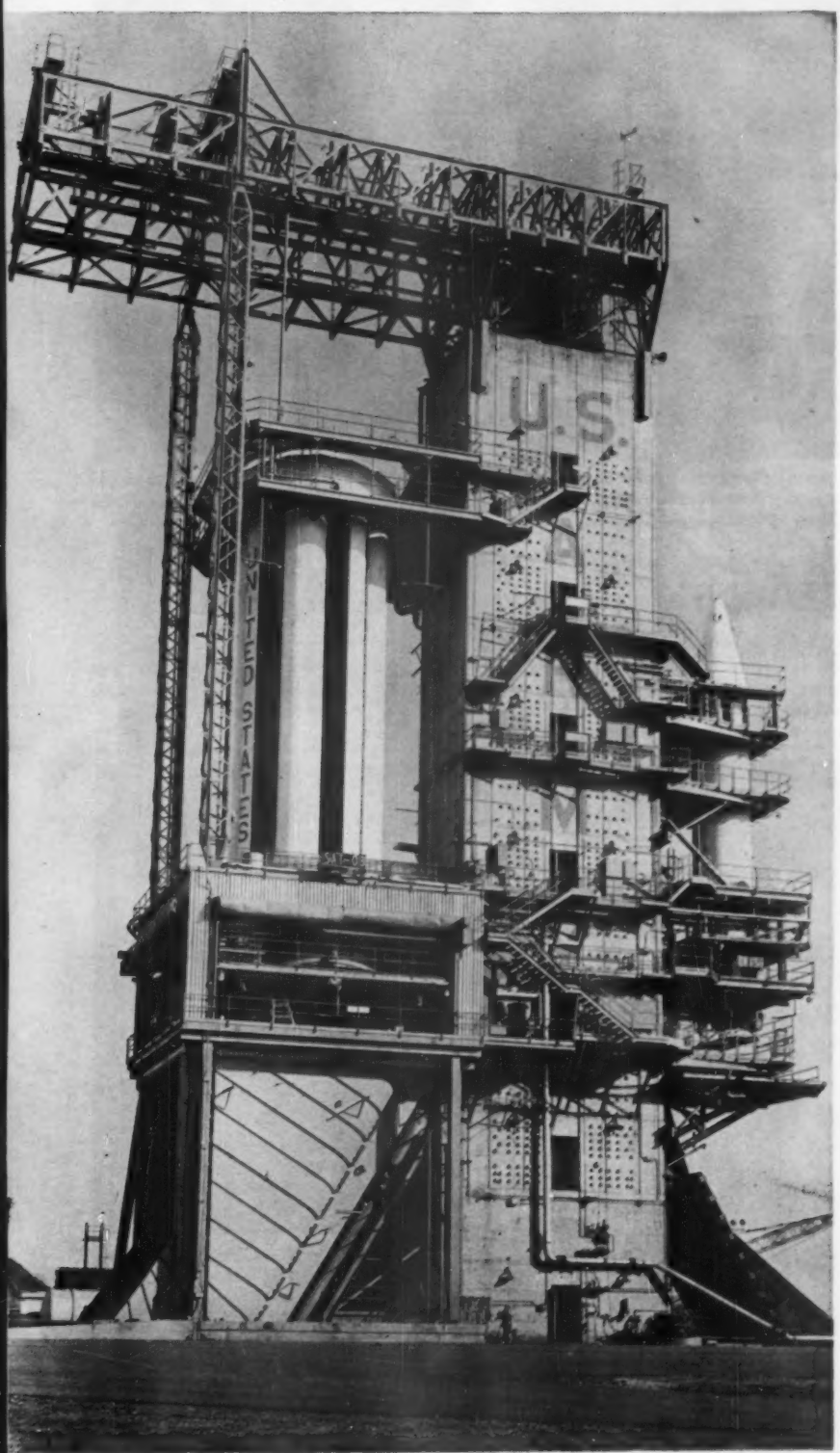
Two SNAP 1-A (system for nuclear auxiliary power) generators, seen in artist's conception, would provide 250 w. of continuous electrical energy to a Discoverer-type satellite for measuring instruments, recording devices and transmitters. SNAP 1-A is prepared for electrical tests (right) at Nuclear Division facilities of the Martin Co., manufacturers of the generator.

Prototype SNAP 1-A Satellite Power Unit Built

Cutaway drawing of SNAP 1-A shows inner components of the 125-watt generator, now undergoing electrical tests by the Martin Co. under a U. S. Atomic Energy Commission contract. The 175-lb. generator is 34 in. long and 24 in. in diameter. Screw-headed caps dotting metal surface mark location of 277 thermocouples, connected in series to produce 125 w. at 28 v. Fuel capsule will contain tightly-sealed pellets of cerium-144, a radioactive material which decays spontaneously, producing heat in the metal surrounding it. System, which will power advanced satellites and space probes, operates independently of the sun and has no moving parts.



Tower Modified for Saturn Static Tests

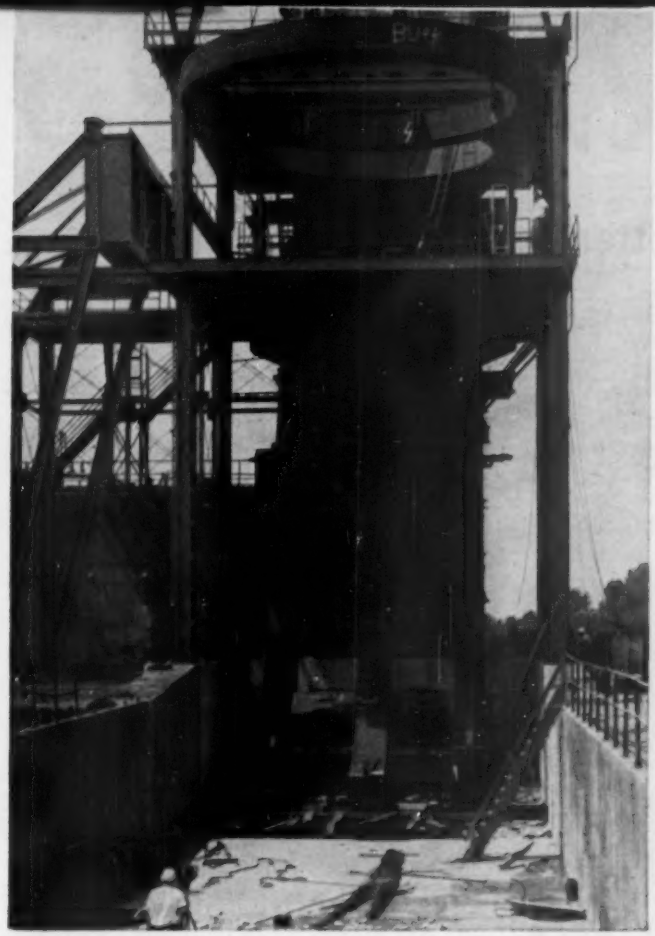


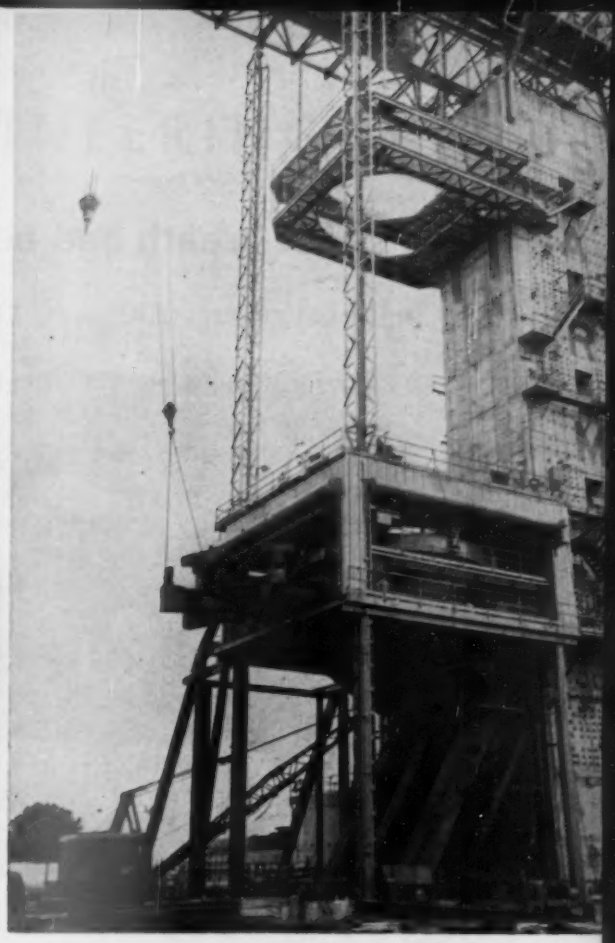
SATURN BOOSTER test tower is shown after modification which increased its thrust capacity from 500,000 lb. to 2 million lb. Large pipe for cooling water is just below the flame bucket. Water is supplied at rate of 40,000 gpm. during firings. Instrumentation in tower allows 820 channels of performance data to be taken simultaneously.

Major modification was required to increase the static test tower at Huntsville, Ala., from a maximum load capacity of 500,000 lb. thrust to 2 million lb. so it could be used in the development of the Saturn S-1 booster. This tower is part of the Army facilities which were formally transferred to the National Aeronautics and Space Administration on July 1 and became the nucleus of the Marshall Space Flight Center physical plant. Superstructure required to carry the booster loads into the reinforced tower is shown in completed form at left. Formerly, both sides of the tower were configured like the framework on the right, where the Jupiter missile is secured.

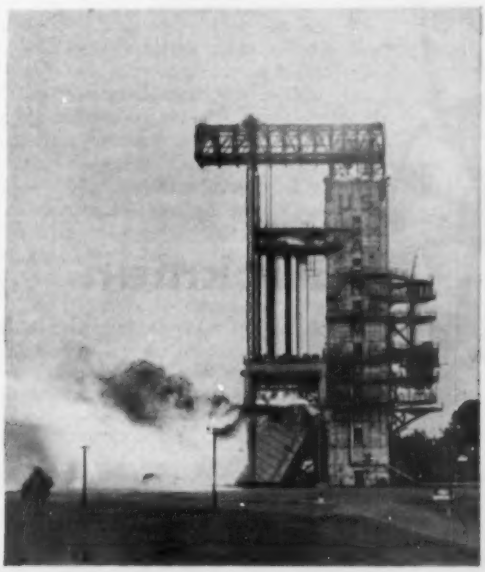
Design of the exhaust flame deflector bucket was one of many problems which had to be handled primarily in an empirical manner. Tests of various types of buckets were made using a cluster of eight 500-lb.-thrust engines. These tests showed that fully enclosed sides were necessary to prevent excessive flame spillage. They also helped develop the bucket curvature and shape needed to stop spillage over the sides of the bucket and prevent reverse flow back up toward the missile base. Initial location of the thousands of tiny cooling water holes in the bucket were also set through these tests. Full-scale firings of the booster have caused unexpected hot spots on the bucket, and additional holes have been drilled to eliminate them. It has been possible to plug up holes in other areas where temperatures have been low during firings. In general, the small-scale tests are credited with saving much work with the full scale bucket, even though it was not possible to get absolutely accurate simulation with the model.

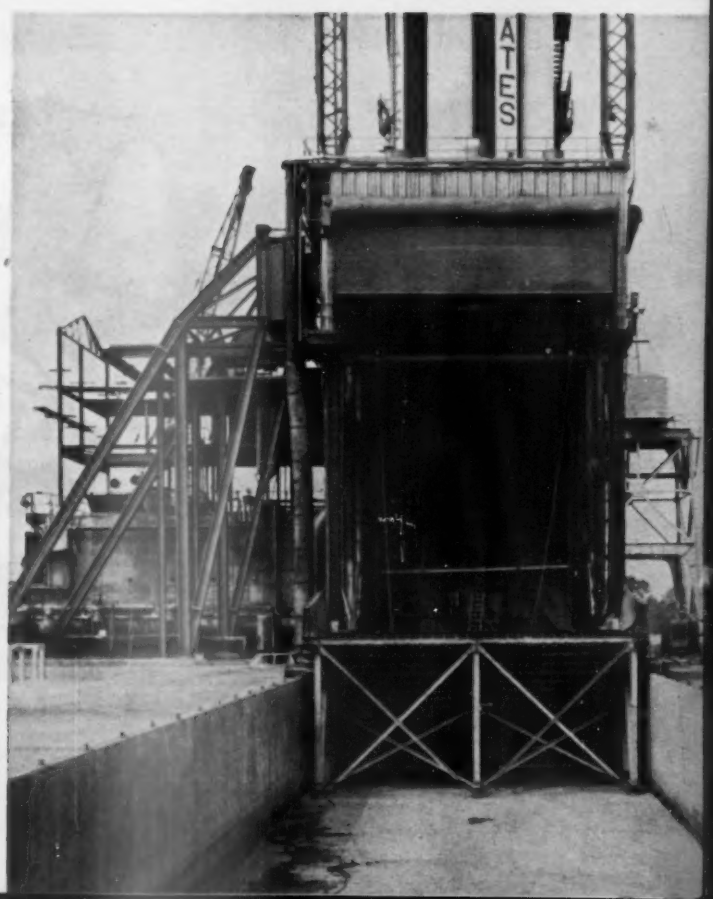
Basically, the thrust measuring arrangement on the Saturn test tower consists of two large steel plates connected by eight vertical rods. The upper plate is secured to the tower by a supporting structure. The booster is fastened to the lower plate assembly, and its thrust load is transmitted to the upper plate entirely through the eight vertical rods. The load on each of these rods is measured by a strain gage load cell of 300,000 lb. capacity mounted on the upper plate. Calibration of the thrust measuring system was accomplished by substituting a large hydraulic cylinder for each engine in the Saturn cluster. The cylinders were attached to the same point on the thrust ring of the lower plate where the engine gimbal blocks are normally attached. Calibration program included applying 140% of the design load and simulating the loss of one engine in the Saturn cluster.





PRIMARY SUPPORT for the water cooled flame deflector bucket on the Saturn booster test tower is provided by three curved beams (left above). Installation of the large thrust ring is shown at upper right. This ring supports the complete booster and transmits its 1.5 million lb. thrust load into the main concrete and steel structure of the tower. Extension on the flame bucket which turns the rocket exhaust flow up out of the deflector pit is shown at right after its completion. A series of large steel fingers break up the flow just before it reaches the lip of the flame bucket extension. Cluster of eight engines is firing below.





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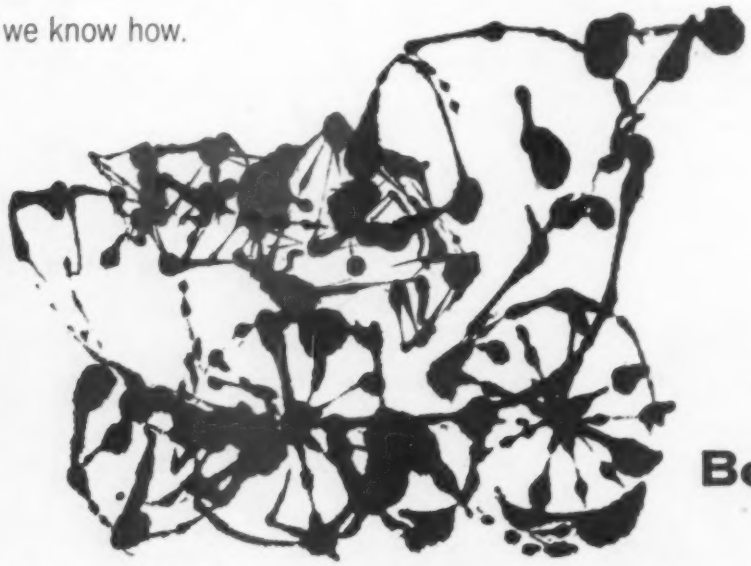

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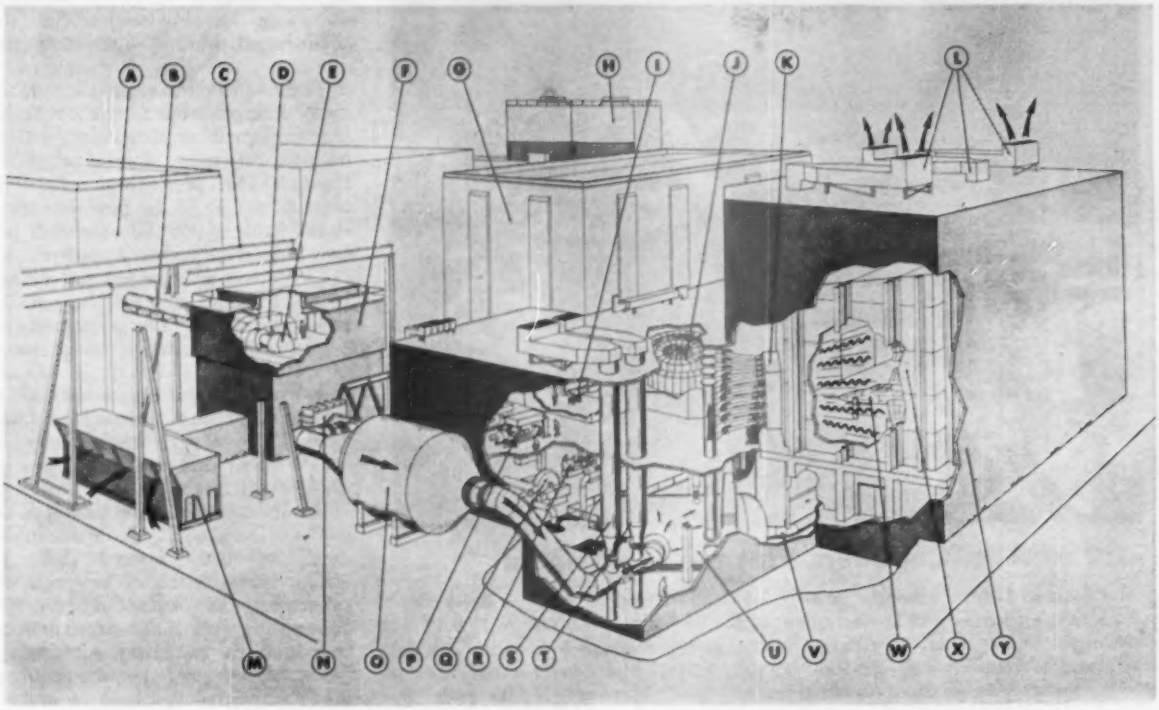


SONIC FATIGUE Test Laboratory to be built at Wright-Patterson AFB will be the largest facility of its kind devoted to research in this area. Details shown in this drawing by DMJM include: A—power house; B—drive shaft and shelter; C—gantry crane; D—gearbox; E—compressor; F—compressor house; G—preparation room; H—cooling tower; I—small-scale test; J—instrumentation and control room; K—main siren bank; L—exhaust mufflers; M—intake filter and shelter; N—after-cooler; O—humidifier; P—siren rotor and modulator drive hydraulic pump; Q—air bearing compressor; R—water pumps; S—surge pipe; T—vent pipe; U—surge chamber; V—air to movable sirens; W—test specimen; X—large test chamber—inner shell; Y—large test chamber—outer shell.

Laboratory to Investigate Sonic Fatigue

By William S. Reed

Los Angeles—Phenomena of sonic fatigue and its destructive effects on missile and aircraft structures will be explored in a new test facility to be built at Wright-Patterson AFB, Ohio. This will be the largest and most thoroughly instrumented sonic test facility in the United States.

Large enough to accommodate ballistic missile or aircraft subsections up to 50 ft. long, the facility will be capable of producing for long periods sound energy levels up to one million watts at frequencies ranging from 10 to 10,000 cps. and up to 174 db. of pressure. Final engineering reports on design, design analysis and design criteria for the building and the complete instrumentation system recently were completed by Daniel, Mann, Johnson and Mendenhall, architects and engineers, for the Air Research and Development Command. This is the first time that an architect and engineering firm has been engaged to carry through on the detailed design of a complete instrumentation system on an integrated contract. By so doing, the building is more specifically designed to the functional requirements of its use than would have been possible by having the facility and instrumentation designed separately, according to DMJM Project Manager G. G. Gould.

Principal Problems

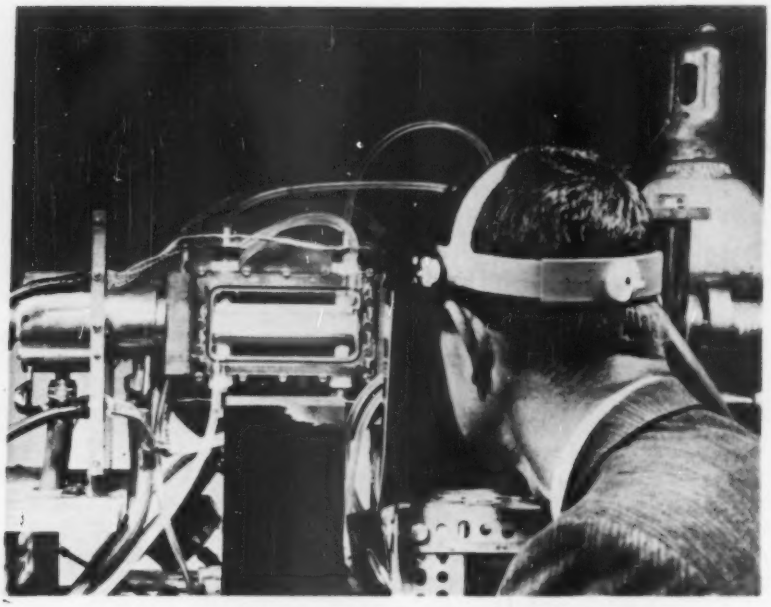
The two principal problems presented by the requirements of the sonic fatigue test laboratory were:

- **Building integrity.** The nature of the tests to be run in the facility is such that ruggedly designed aircraft and missile subsections will be subjected to destructive forces not clearly understood. To prevent the tests from destroying the building in which they are conducted, "square" corners and flat surfaces have been eliminated to control sound reflection and resonance.
- **Noise attenuation.** Noise equivalent to the roar of large ICBM boosters will be simulated in the chamber by a bank of 25 sirens and can be sustained for any time desired. Anechoic-like design of the building, plus a muffled exhaust to draw off air delivered to the siren bank, will attenuate noise to a satisfactory level outside the test chambers.

The sonic fatigue test laboratory will be built on the site presently occupied by the obsolete 20-ft. wind tunnel at Wright Field. Portions of the tunnel will be adapted for use in the new test facility, such as a 40,000 hp. electric motor, a 75-ton overhead gantry and parts of existing buildings. Certain portions of the wind tunnel foundation also will be used.

New construction necessary will consist of a large test chamber, small test chamber, control room, test support area, siren room and siren support area, switch gear and electrical equipment space. Existing portions of the present facility will be converted for use as a preparation room, data analysis room and powerhouse.

The large test chamber is of double-



Allis-Chalmers Plasma Jet Tunnel

Allis-Chalmers' Defense Products Division and MHD Research, Inc., are developing a crossed-field acceleration (XFA) wind tunnel with a goal of plasma heated to 25,000F and traveling at 18,000 mph. Joint project uses magnetohydrodynamic forces to accelerate the plasma to extremely high velocities. Partially assembled accelerator section is shown above. Prototype has produced plasma jet heated to 20,000F, traveling at 9,000 mph.

wall type construction with both inner and outer walls having separate foundations to preclude the transmission of vibration between the two. An access door measuring 18 x 16 ft. is provided to minimize the necessity for assembly of test specimens after they are placed in the chamber.

Acoustical requirements have dictated the geometry of the large test chamber. To produce a diffuse or random sound field, it is essential that the walls of the chamber be extremely hard and irregular in shape. However, to do progressive wave testing, the inside walls of the chamber must absorb substantially all of the sound energy and reflect as little as possible. Therefore the room surface requirements for random incident testing contradict those required for progressive wave testing. DMJM has solved this by designing a retractable sound absorbing acoustical treatment which can be positioned over all the inside wall surfaces. This treatment consists of material which will capture up to 95% of the sound energy and can be retracted into specially designed cabinets on the walls of the chamber when not in use.

The small test chamber will be used primarily for instrumentation calibration and testing of small units in a 1 x 1 ft. test section. Both chambers can be operated simultaneously.

Sonic testing will be required principally in the frequency range from 50 to 24,000 cps. Testing at reduced power will be required in the high frequency range up to 10,000 cps. Sonic fatigue in flight vehicle structures generally is concentrated in the frequency range between 100 and 1,000 cps. and maximum acoustic power capability of this facility will be in the latter frequency range.

The siren sound source for the large chamber is designed to produce a maximum acoustic output of one million watts. Principal sound source for the large chamber will consist of a bank of 25 pure tone sirens which can be operated together synchronously or independently. The bank of sirens is positioned in the wall at one corner of the large chamber. The mode of operation and control of the sirens will be governed remotely in the control room from a preprogramed tape recording, or manually if desired. The main bank of 25 sirens will cover the frequency range from 50 to 2,400 cps. Ten auxiliary pure-tone sirens will extend the high frequency range to 10,000 cps. The high frequency sirens will be positioned at specific locations within the large chamber, depending upon test conditions.

There will be two other sirens in the chamber in addition to the 10 smaller high-frequency sirens. These will be operated at many locations in the chamber. One of these sirens will be identical to one of the pure-tone sirens in the bank of 25; the other will produce broad band, or white noise.

The sirens will be fed air at from 10 to .05 psig. and will be powered hydraulically. For the propagation of random noise levels, the sirens can be set individually to operate at different frequencies and also can be set to operate in unison to produce pure tone levels. Phase angle of the rotor blades in all sirens can be maintained to within 0.5 deg.

White noise can be produced by random actuation of hydraulically-variable modulator plates.

The siren bank can be controlled automatically so that the tape-recorded noise of a rocket engine at launch can be fed into the test chamber instrumentation system and automatically reproduced by the siren bank.

A signal amplifier room is located beneath the large test chamber and data signals from both test chambers will be routed into the room and then fed into signal conditioning equipment, coding equipment and amplifiers. The conditioned data signals then are directed to a patch panel in the control room.

The control room is located between the small and large test chambers. Instrumentation equipment for both chambers is in this room including patching, monitoring, data analysis, recording, safety and communication equipment, a status panel, data control consoles, facility control consoles, and the siren control console and equipment. Test engineers will be able to monitor and analyze data, and will be able to control data flow, facility equipment and sirens during a test, solely from the control room.

Data analysis is conducted in three rooms: an editing room, digital preparation room and detailed analysis room. Editing room provides a quick-look type of analysis of the recorded data. Here the data may be reproduced to review test results and to edit and record data for further detailed analysis. The room contains a 12-channel, wide frequency-band oscillograph, oscilloscopes, meters, and a control console for automatically searching the recorded test data tape.

The analog output signal from any of the analysis instruments may be translated into digital form on IBM

Construction Contract

Opening of the bidding period on proposals for construction of the Sonic Fatigue Test Laboratory was recently announced by the U. S. Army Corps of Engineers. Bids will open on July 28 and the construction contract will be let during August. The test facility is scheduled for completion in Nov. 1961.

punched cards in the digital preparation room. This room also contains a programed card sorting machine that presents the resultant data in digital form or reconstructs it back into analog form on graph paper.

Detailed analysis area, in addition to the usual monitoring instruments, contains instrumentation for performing octave band, 1/3 octave band and narrow band frequency analysis, power spectral density analysis, cross correlation analysis, and amplitude distribution analysis. Tape recorders, a control console for programing the tape recorders and tape searching equipment for selecting specific data samples from recordings made during a test, also are provided.

The instrumentation system specified, and in some cases designed by DMJM, performs the following functions:

- **Measures and records** individual data signals simultaneously and continuously for from 10 to 20 hr.
- **Provides control and programing** functions for the instrumentation system itself, the sirens, the air compressors, and facility, e.g., auxiliary air-equipment, doors and anechoic curtains.
- **Establishes a means** for analyzing data during and after a test.

The instrumentation system itself is self-checking and contains a fail-safe interlock system that serves to protect the operating personnel and equipment. A high degree of automation limits the number of personnel required for operation, provides the response necessary for over-all safety, and permits a rapidity of measurement handling and analysis of data that would be impossible if manual control was used.

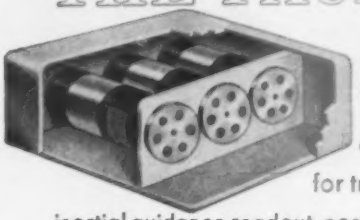
Two consoles are employed to control conditions of the test and the data recording. The test control console programs the input of conditions to the test specimen. Inputs can be controlled either automatically through a preprogramed tape or conducted manually.

Data control console records on magnetic tape the reaction of about 70 pickups in the form of microphones, accelerometers, temperature probes, strain gages and thermocouples. A slow commutating system permits a saving in recording tape because, rather than a continuous monitoring of all channels of information, a time-sharing plan is used. Among the features of the data analysis system is a tape editing system which permits a particular type of data to be automatically selected for review. A correlation analyzer is employed, permitting comparison of large quantities of data by automatic means. A card punch memory system plus automatic plotting also is incorporated in the data analysis setup.

THE 'PARTS'

The "parts"...synchros, resolvers, servomotors, tach-generators, potentiometers, custom gear trains. Every type of precision component required for high-performance servo subsystems. All developed by servo-wise Giannini engineers.

THE PACKAGE



The package...a servo subsystem developed by Giannini, of Giannini components. Whether for tracking, flight control, fire control, inertial guidance readout, position follow-up repeaters, coordinate conversion, DC signals for synchro or transducer outputs.

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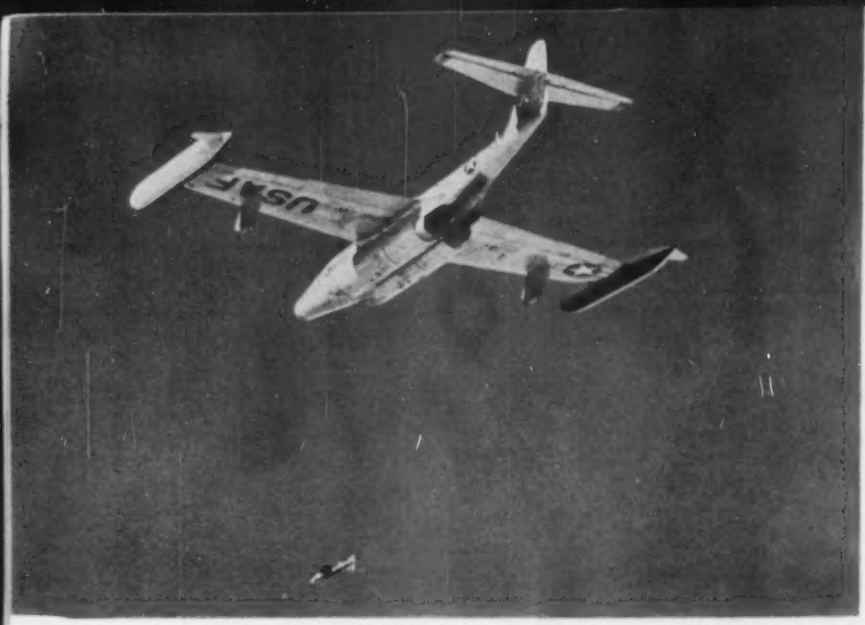
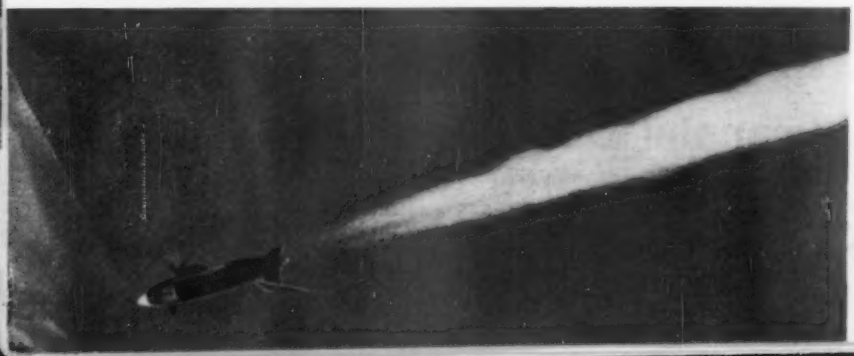


Radioplane RP-76 radio-controlled target (being dropped from Northrop F-89) is being used in Nike Ajax firings at McGregor Range, Ft. Bliss, Tex.

RP-76 Target Used in Nike Ajax Firings

F-89 turns away as ground controller takes over actual flight run. Target has reached Mach .94 pushed by Aerojet solid propellant rocket motor (AW Dec. 7, 1959, p. 64). Target is recoverable by parachute on ground command, or automatically if hit. Note inverted tail section (below); control is by canard vanes.



Scaife Alloy Used In Polaris, Falcon

New York—Scaife Co. has developed an ultra-high strength steel called MX-2 which is now being used in fabrication of prototype rocket cases for the Polaris submarine missile and 12-in.-diameter Super Falcon missiles.

Material is under investigation by Thiokol Chemical Co., Aerojet-General and Lockheed Aircraft, among others, who are using it in production of prototype missile components. It is believed that MX-2 also is being studied for possible use in Minuteman, Pershing and Nike Zeus rocket motor cases.

One leading rocket scientist estimates that use of the new alloy could increase the range of a 3,600 mi. solid propellant missile by more than 50%. Scaife says that by using MX-2, design requirements can be met by using only one-half to one-third as much metal as would otherwise be required, with corresponding gains in space and weight.

MX-2 is a cobalt-modified, low alloy, high strength steel with a burst strength of about 280,000 psi. In uniaxial tensile tests, MX-2 reached a 0.2% offset yield strength of 225,000 to 235,000 psi. and ultimate tensile strengths of 275,000 to 290,000 psi.

Steel reportedly has good weldability, machinability and low notch sensitivity.

Chemical Blast Effects To Be Investigated

Washington—Chemical blast effects at high altitude will be studied under a proposal to detonate 500 lb. of dynamite at 125,000 ft. above the White Sands Missile Range, N. M., next spring. The charge will be carried aloft in a 300-ft. balloon and detonated by radio link. Instrumentation will record shock waves, pressures, accelerations and heat.

Called Project Banshee, the experiment is expected to furnish basic information for the design of missiles, anti-missile missiles and aircraft to withstand blast effects in the high altitude environment.

The project is being coordinated and funded by the Defense Atomic Support Agency, with the three military services participating. Contracts will be let early next year, DASA said.

Lacrosse Follow-On Contract Awarded Martin

Martin Co. will continue production of the Lacrosse surface-to-surface missile under $18 million Army contract. The solid propellant Lacrosse is produced at the company's Orlando, Fla., division.

Raytheon's New Scan Conversion System Provides Memory, Brightness, Alpha-Numerics, Instant Erase

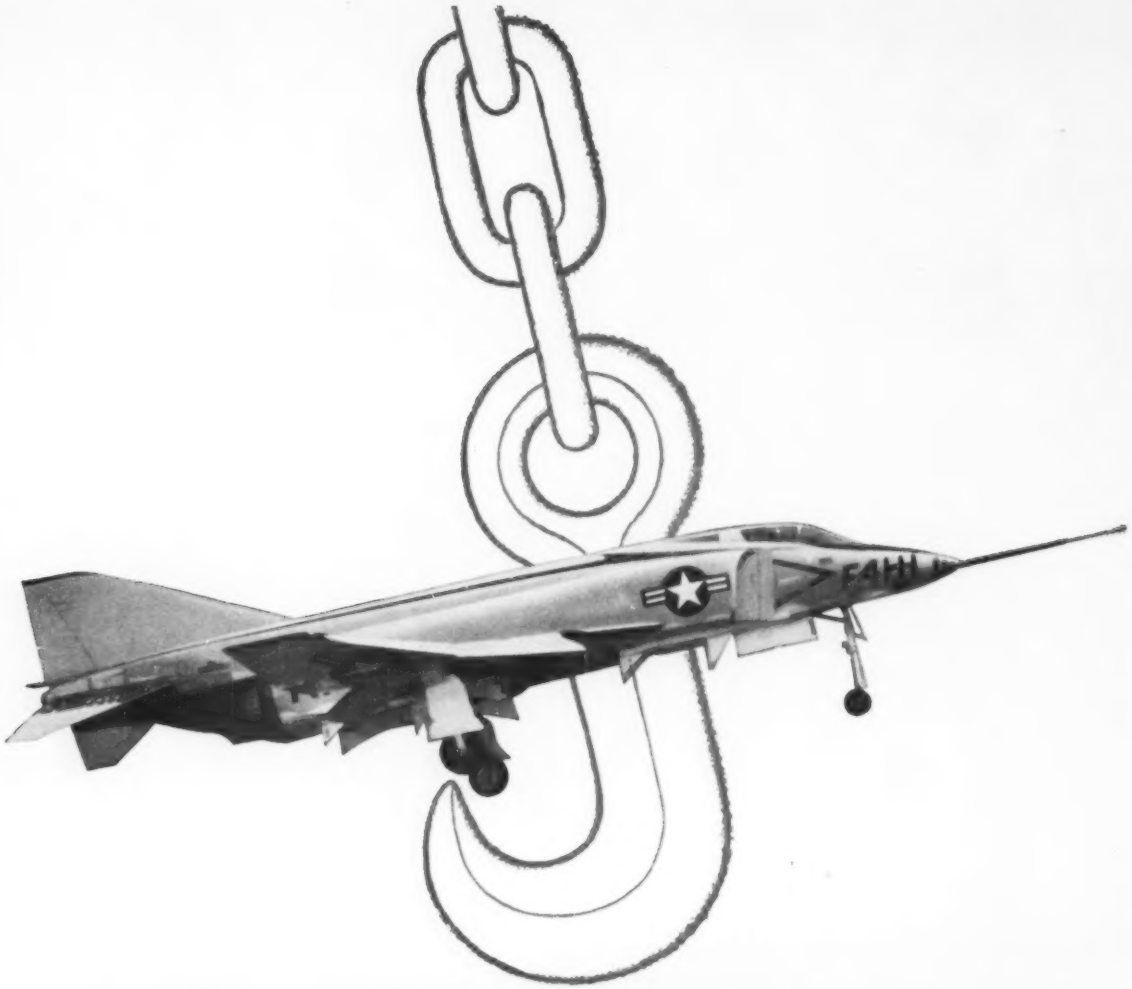
Raytheon's New Scan Conversion System achieves and improves air traffic control with: continuous . . . accurate . . . bright display of all target-in-area information. MEMRAD, the display's two-gun cathode ray tube, stores, converts, and projects radar data on any number of TV monitors. Image is 300 times brighter than conventional PPI. Targets show as continuous trails from which speed, position, direction may be read or transmitted electronically.

The display also provides instant image erase, and generation of alpha-numeric symbols that lock on and move with target automatically. Masks, subnormal room illumination, all human error related to oral-manual plotting are eliminated. Superimposition of maps, off-centering, large screen TV projection make Raytheon's SCS the vital element in more sophisticated systems.

RAYTHEON EQUIPMENT DIVISION

Excellence in Electronics

For Raytheon Scan Conversion Brochure,
Write: Director of Marketing, Equipment Division, Dept. A1, Raytheon Company, West Newton, Mass.



"SKY HOOK"

Landing speed of the McDonnell F4H reduced 8% by Solar built boundary layer control system

BOUNDARY LAYER CONTROL—achieved by bleeding air from the propulsion engine and directing it at sonic speeds over wing control surfaces—reduces by 10 knots the landing speed of McDonnell's F4H fighter.

Designed and manufactured by Solar, the F4H boundary layer control system makes possible safe, efficient carrier landings. Made from high strength, heat treated Inconel X, the lightweight system weighs only 98 lbs. It is tested to 172 psig and operates at 778F. Ducting wall thickness is .012 in. A special design feature allows passage of the ducting system through folding wing joints.

If your needs involve the design, testing and production of complete ducting systems for aircraft or missiles, call on Solar's proven capabilities in the field. Write today to Dept. H-134, Solar Aircraft Company, San Diego 12, California.

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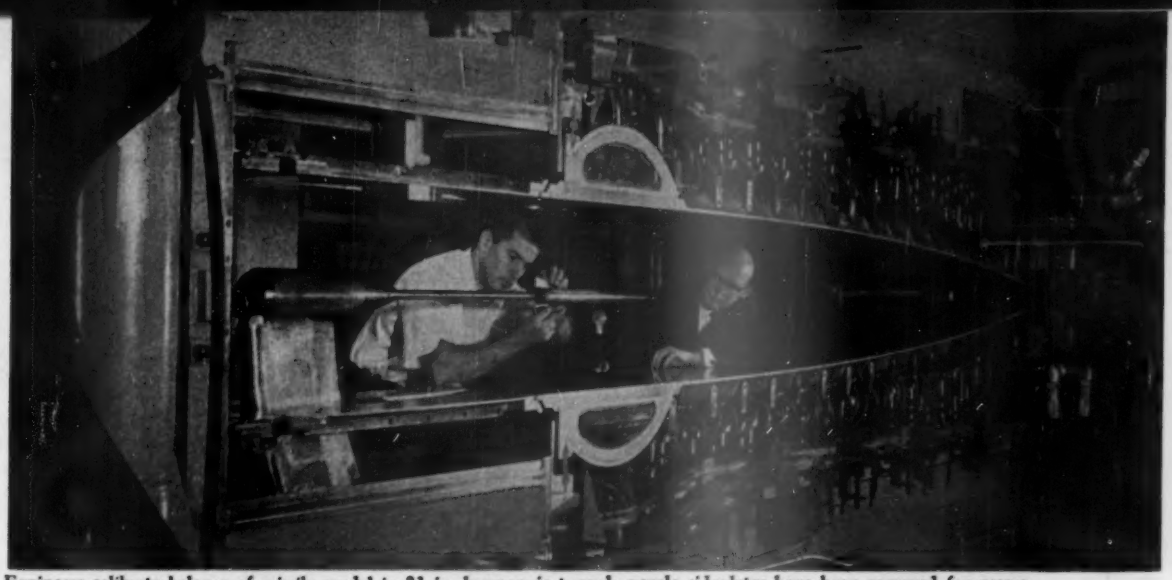


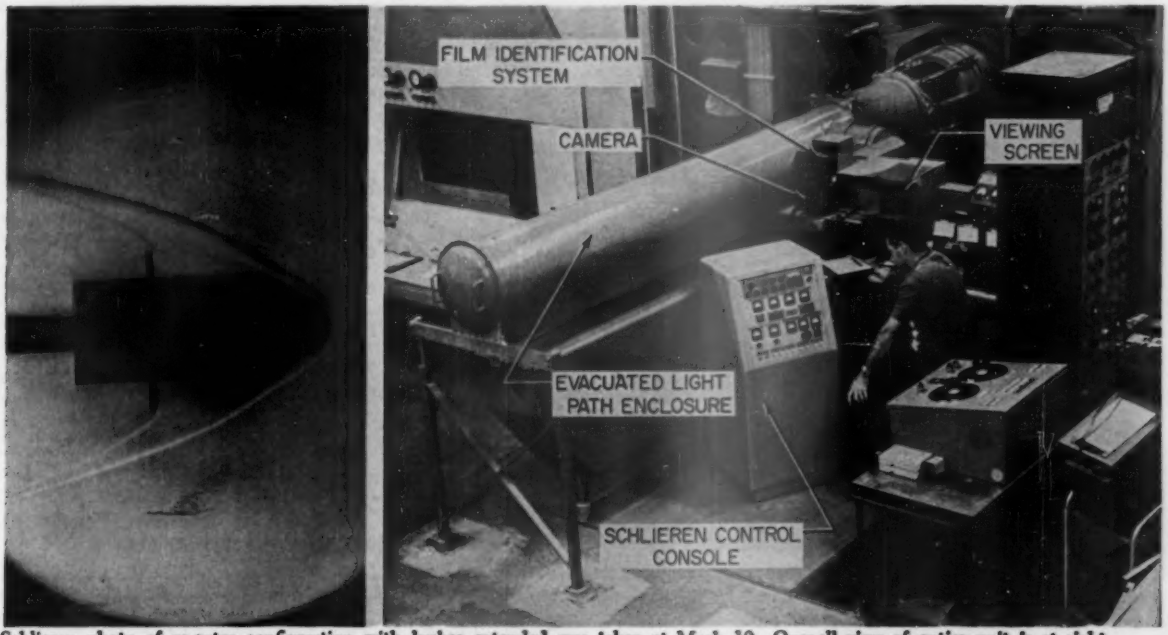
Engineers calibrate balance of missile model in 21 in. hypersonic tunnel; nozzle sideplates have been removed for access.

Schlieren Unit Uses Vacuum to Cut Distortion

Pasadena—Schlieren optical system distortions caused by room air becoming disturbed when it contacts the hot quartz viewing windows of Jet Propulsion Laboratory's hypersonic wind tunnel have been eliminated by placing the optical components in a vacuum chamber. Since the extreme sensitivity of schlieren optics requires mounting on a firm base, JPL designed a vacuum tank surrounding the optical components, which are isolated from the tank at points where mounts and optics controls pass through the walls by bellows expanding and contracting with room atmospheric variations, without disturbing the ten-thousands-of-an-inch tolerances to which optics are aligned and controlled. When tunnel is operating at high Mach numbers and low atmospheric density, air flow temperature approximates 1,350F. Water circulating through tunnel structure and test section keeps these parts cool along with the edges of the windows. However, from the 75F condition at the edges, temperature rises steeply to the center of the window. During buildup to operating levels and throughout runs, adjustments are required on optical system elements as variations occur in tunnel conditions.

Provisions also are made for scanning the 18-in.-dia. test section windows with a 12-in.-dia. light path, accomplished by crossfeed controls on the optics and their support leg extensions within the vacuum chamber. System is versatile in the types of optical data obtainable.

Basic schlieren may be arranged in either Newtonian or Herschelian manner. Light source can be either a steady mercury vapor BH-6 bulb operating in a watercooled housing, or a one-microsecond, intermittent-spark source operating at 7 kv. Light cutoff may be either circular or slit shape, with variable diameter for the circular orifice and variable angular orientations, width and length of the slit. Once selected and started, photographic sequence is completely automatic.



Schlieren photo of re-entry configuration with brakes extended was taken at Mach 10. Over-all view of entire unit is at right.

Perceptron Shows Its Ability to Learn

By Philip J. Klass

Buffalo, N. Y.—Mark I Perceptron, a machine which can be taught to discriminate between different shaped objects and to identify them without prior knowledge of their form, in much the same way that a child learns, was demonstrated here recently by Cornell Aeronautical Laboratory.

The present machine is a relatively simple one, with limited capability, intended only to demonstrate feasibility and permit easy experimentation. In a more sophisticated version, a Perceptron might be used to automatically scan aerial reconnaissance photos and identify objects whose shapes mark them as targets.

The Perceptron program here is sponsored by the Office of Naval Research with some funding provided by the Rome Air Development Center. ONR also is sponsoring programs in "cognitive machines," as the Perceptron is sometimes called, at a number of other facilities.

Although the Perceptron today is little more than a laboratory curiosity, many observers believe the basic concept of machines that learn may have a greater impact on warfare and industry than the digital computer which itself was a laboratory curiosity little more than 10 years ago. The Perceptron concept was developed by CAL's Dr. Frank Rosenblatt, a psychologist with an electronics aptitude, in search of a possible model for the human brain (AW July 7, 1958; p. 60).

In a representative demonstration, the Mark I Perceptron is able to correctly identify every letter in the alphabet after it has been exposed to each letter 15 times and has been told the identity of any letter it fails to correctly identify during the 15-exposure training period. Because of the limited size and complexity of the Mark I, the letters are all of a single type face (style) and are always located in a fixed position relative to the background.

Human Trainer

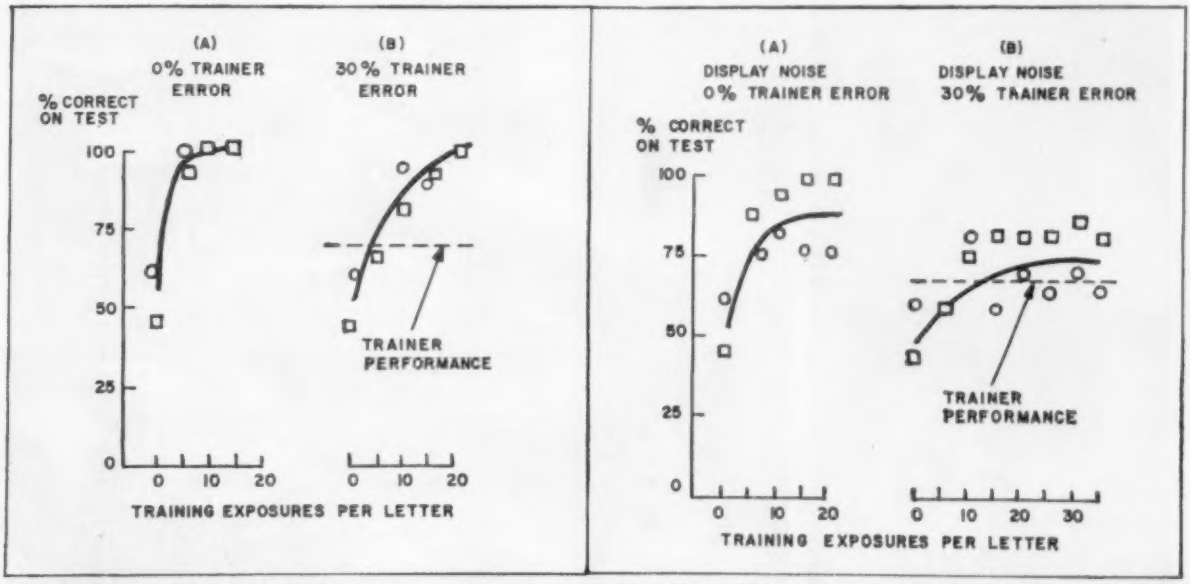
This ability to read letters should not be confused with existing machines which are specifically instructed (programed) to read letters or numbers. When the Perceptron begins a problem, it doesn't know whether it will be asked to read letters, numbers, or to sort squares from circles. The Perceptron learns what it is supposed to do from a human trainer who tells it when it makes a mistake and then gives it the correct answer.

For example, one letter of an alphabet is placed in front of an array of 400 photo-cells, which serves as the retina of the Mark I Perceptron. If the letter is an "A," and the machine incorrectly identifies it as a "B," the human trainer operates controls which tell the machine that the letter is an "A," not a "B." If the machine identifies the letter correctly, more likely to occur after some training than at the start, the human trainer takes no action.

Then another letter (not necessarily the next one in the alphabet) is placed in front of the photo-cell retina, and the process is repeated. By the time the Mark I Perceptron has viewed every letter of the alphabet 15 times, it can subsequently identify every letter correctly, CAL's tests indicate.

The procedure presently used to educate the machine, called "corrective training," requires action by the human trainer only when the machine makes a mistake. Earlier technique, called "forced learning," required the human trainer to not only correct the machine when it erred, but also to inform the machine every time it made a correct decision. Technically, this is termed "reinforcement."

Tests indicate that the machine reaches a higher level of proficiency with corrective training than with forced learning. Using eight letters of the alphabet, but placing them in different locations on the Perceptron's retina (which complicates the machine's identification task), Cornell Aeronautical Laboratory finds that with forced learning the machine's performance levels off at about 70% correct answers.



PERCEPTRON can learn to distinguish between two different objects (letters "E" and "X") despite errors intentionally introduced by its human trainer or due to his own inability to distinguish between objects. In less than five exposures, machine outperforms trainer and eventually reaches 100% accuracy (left). Random noise causes some degradation of performance (right).

whereas with corrective training it rises until the machine achieves 100% accuracy.

In certain situations, however, the forced learning teohnique appears superior. For example, if the problem of identification or discrimination between two objects is so difficult that even a human operator can not identify them correctly every time, it might be assumed that a Perceptron could never hope to achieve better performance than its human instructor. But if the forced learning technique is used, the machine soon is outperforming its human instructor.

To demonstrate this, CAL conducted an experiment in which the Perceptron had to distinguish between two letters, "E" and "X," a task made more difficult because they were not always placed in the same position on the machine's retina.

Instructor Misleads

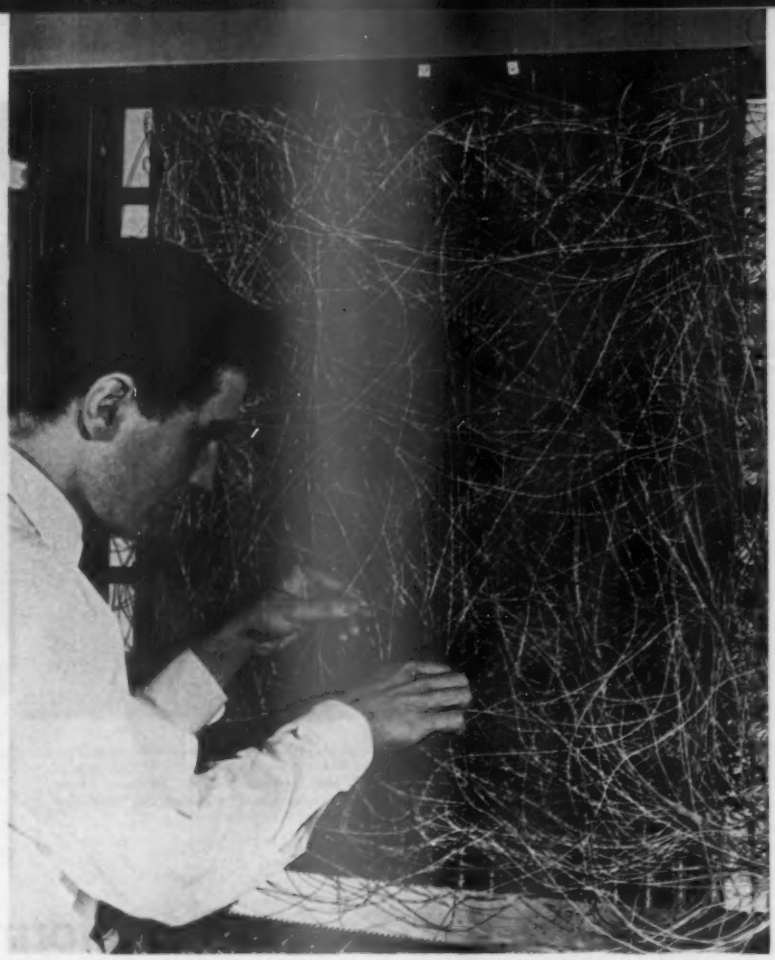
In 30% of the letter exposures, the human instructor intentionally misled the machine. That is, 30% of the time when the machine incorrectly identified one of the letters, the instructor advised the machine that it was correct.

When a correctly instructed Perceptron achieved a 95% correct performance after about five exposures to each letter, the incorrectly instructed machine required about 15 exposures to reach the same performance figure. But after 20 exposures, the machine could identify letters correctly 100% of the time and it effectively ignored the bad advice coming from the human instructor.

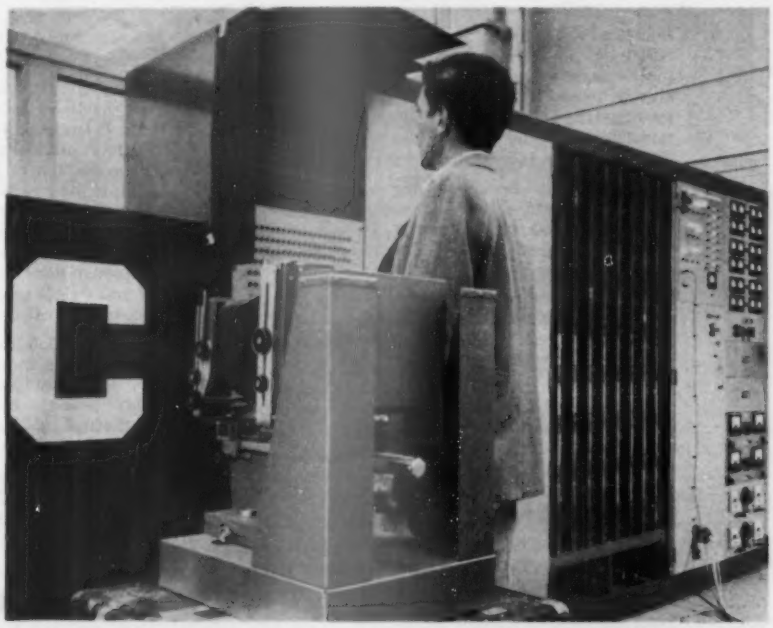
Cornell conducted another test to determine the effects of random noise on the machine's ability to learn its task. In this experiment, noise was introduced by means of a random pattern of spots superimposed on each letter exposure, with a different pattern for each individual exposure, using again the letters "E" and "X." This experiment, like the earlier one with intentional trainer error, was carried out in duplicate using two halves of the machine.

The noise gave the machine a little trouble, causing its performance to level out at around 85% correct answers. When noise was combined with intentional training errors for 30% of the exposures, performance dropped to about 75%, but still was slightly better than the performance of the instructor.

Although CAL's Dr. Rosenblatt does not claim the present Perceptron bears any close resemblance to the human brain, there are many striking similarities. For example, certain portions of the human brain can be removed in surgery without serious loss of human capability. CAL scientists decided to see how "surgery" would affect the per-



PERCEPTRON'S 400 photo-cell sensors are connected by this random-wired network to machine's 512 Association Units, with 10 sensory output connections to each of the Association Units. Sensors are mounted in a 20 x 20 matrix as machine's basic input mechanism.



MARK I Perceptron, experimental pattern recognition machine, can learn to identify objects and patterns, such as letters of the alphabet, without prior knowledge of their format with the aid of a human teacher. Machine, built by Cornell Aeronautical Laboratory, was intended to prove Perceptron principles proposed by CAL scientist (AW July 7, 1958, p. 60).

Tucked neatly into the nose of the Lockheed QF-104 is the Chatham Y-Series silicon transformer-rectifier, 28VS200Y, delivering 200 amps, 28 volts d.c. A second unit is positioned on the starboard side in the electrical load center of the airplane. These units are normally operated in parallel but each is capable of supplying the entire d.c. load upon which the QF-104 depends to carry out its mission.

Chatham Y-Series Transformer-Rectifiers Assigned Key Role in LOCKHEED QF-104

Lockheed's QF-104 adds double-barrelled potency to our air defense arsenal. An advanced version of the 1500 mph missile-carrying F-104—holder of the world's altitude mark (103,395.5 feet) plus eight time-to-climb records—the QF-104 can streak away on its space-age missions with dual effectiveness: either as a piloted aircraft or a remote-controlled drone.

According to Lockheed, the availability of d.c. power is an essential factor in assuring satisfactory mission performance of the QF-104. To furnish this vital power, Lockheed selected Chatham's dynamically new 200 ampere Y-Series silicon transformer-rectifiers.

There were many important reasons for this choice. Lockheed demanded the utmost in high-level flight performance and reliability, while restricting space and weight requirements to an absolute minimum. The Chatham Y-Series T-R's delivered.

Unsurpassed for proven reliability, the Chatham Y-Series transformer-rectifiers are available in a complete range of outputs—from 20 amps to 200 amps. Volume for volume and size for size these new "Y" units are smaller and lighter than any competitive equipment with similar capabilities. For instance, this 200 amp QF-104 unit weighs under 17 pounds and occupies less than 310 cubic inches.

Satisfying rigid specifications and critical performance levels for missiles, jet aircraft and commercial airliners is second nature to Chatham. That's because Chatham maintains complete control of every step in the production of power conversion equipment. For example, by producing its own solid-state elements—whether silicon, germanium or selenium—Chatham designers are not limited by the "specs" of commercially available components. By strictly controlling component dimensions and reliability, Chatham keeps size and weight to a minimum, while satisfying precise electrical specifications.

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formance of the Perceptron by cutting out portions of the machine's distributed memory (Associated Units).

As Association Units were randomly disconnected from the Perceptron, it was again subjected to the "E"/"X" discrimination tests after each surgery. As the machine lost its Association Units, there was a gradual decline from the original 100% performance level. But even with ¾ths of the Association Units removed, the machine still gave correct response 75% of the time, according to CAL's Albert E. Murray.

Reconnaissance Use

CAL currently is studying the possible application of the Perceptron to the interpretation of aerial reconnaissance photographs where the machine would be required to pick out suitable targets from a confusing variety of backgrounds. The machine was trained to identify circles and "Xs," then was exposed to these shapes plus squares, triangles, dots and random lines. The results of these tests indicate that the machine can consistently recognize the desired objects when they appear by themselves or on strange backgrounds. If the Perceptron is exposed to figures whose forms are similar to objects which the machine is trained to detect, the machine may be fooled unless it is also trained to ignore the unwanted configurations.

These limitations are believed to result from the relatively limited capability of the Mark I, rather than being inherent in the basic concept. The Mark I has only 512 Association (memory) Units, compared with a figure of about 10 billion estimated to exist in the human brain.

Although the present CAL unit operates with visual inputs, the Perceptron can operate with any type of input. For example, a Perceptron designed to operate from audio inputs might be able to recognize spoken language and to convert it into signals suitable for operating an electric typewriter. Such a machine could be used to convert the spoken word directly into the printed word.

Cornell Aeronautical Laboratory scientists currently are designing a Mark II Perceptron which will have the equivalent of 20 times as many memory units as the Mark I, as well as a more sophisticated system of interconnection of memory units.

Perceptron Elements

The Mark I Perceptron consists of three basic types of elements:

• **Sensor Units:** The Mark I uses an array of 400 tiny photo cells mounted in a 20 x 20 matrix as the machine's basic input mechanism. For convenience, the photo cell matrix is mounted in the focal plane of a camera which is trained on the object or objects to be identified.

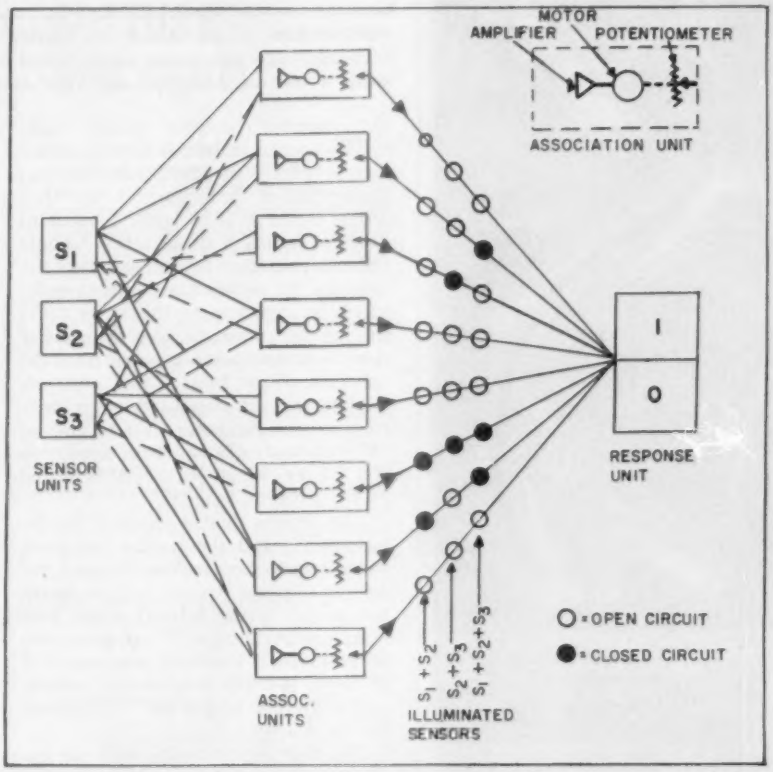
• **Association Units:** The output signals from the sensors are connected in random fashion to Association Units (A-Units) which serve as the machine's memory. Each of the 512 A-Units in the Mark I contains a threshold detector which determines from the amplitude of the sensor signal whether the particular A-Unit should be connected into the machine. The output signal of an A-Unit is generated by a small d.c. motor-driven potentiometer, which can be operated by the human instructor to change the magnitude (and/or polarity) of the A-Unit output.

• **Response Unit:** The output signals from all active (connected) A-Units are summed up by a device known as the Response Unit, which also serves to indicate either of two conditions or situations. For example, if the machine is to discriminate between an "E" and an "X," one situation represents the machine's conclusion that the object is an "E," the other that it is an "X." The Response Unit (R-Unit) reaches its conclusion by comparing the combined amplitude of signals received from all of the A-Units with a predetermined value.

Where more than two objects are to be identified, additional Response Units are employed and connected in binary fashion.

For example, to identify each of 26 letters in the alphabet, the Mark I uses five R-Units which collectively can indicate 32 (2^5) different situations.

Considering the simplest type of problem, where the machine must discriminate between two letters, such as "E" and "X," here is how the Perceptron is trained. A letter "E" is placed in front of the optical sensors, and the machine will attempt a decision, usually wrong if it is completely untrained at



SIMPLE PERCEPTRON, to explain principle of operation, has three sensors, each with total of eight output leads which are connected in completely random fashion to eight Association Uni's (A-units). Whenever sensor is illuminated, it produces equal positive and negative polarity output signals. When algebraic sum of all sensor signals into an Association Unit exceeds preselected value (equal to one positive sensor signal in this example), output signal from motor-driven integrator potentiometer in A-unit is connected to central response unit. Total sum of signals from these connected (active) Association Units is compared with predetermined value by response unit to make a decision. (Light and dark circles are used to show which Association Units would be active under three different combinations of sensor illumination.) If Response Unit decision is incorrect, human instructor forces machine to correct decision, which causes feedback to integrator motor in each active Association Unit, causing it to alter setting of potentiometer. After such a "training period," Perceptron will make correct decisions.

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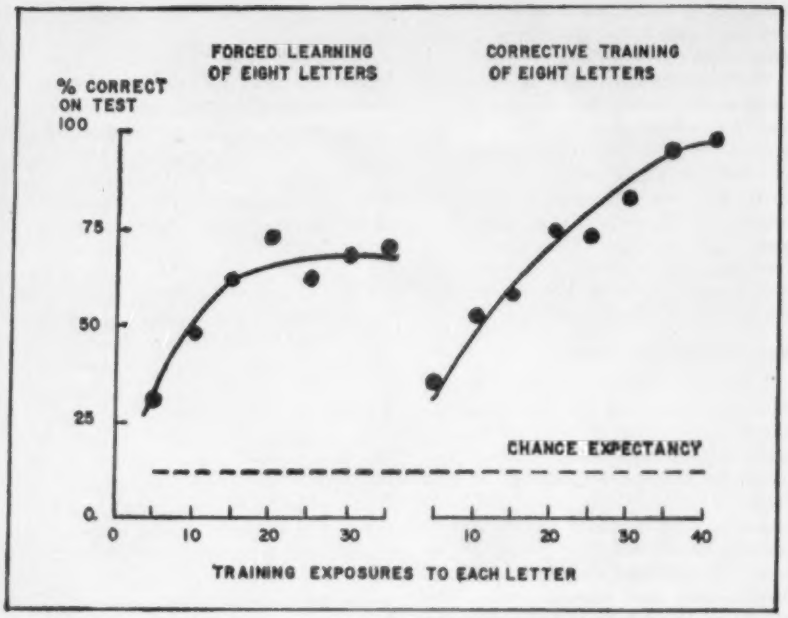

PERCEPTRON quickly "learns" to identify each of eight alphabet letters when it is "rewarded" after each correct answer (forced learning), but it achieves a higher performance when it receives instruction only after making a wrong decision (corrective training).

the moment on the specific task.

The human instructor then pushes a button which, in effect, tells the machine that it is looking at an "E." What this does is to apply a signal to the d. c. motors of all the active A-Units (which have been connected into the machine by signals from sensors energized by exposure to the letter "E") causing the motors to move the arms of their respective potentiometers until the collective output from all active A-Units is of the correct amplitude and polarity to cause the Response Unit to give an "E" response. This in effect conditions the A-Units which have been activated by the pattern of an "E."

The process then is repeated for the letter "X," and the human instructor again forces the machine to give the correct response, which in turn signals the motors in the A-Units which have been activated by the "X" to drive their potentiometers until the total output of all active A-Units is of correct polarity and magnitude to give an "X" response by the R-Unit.

The training continues, with the machine being exposed to "E" and "X." When the machine correctly identifies the letter, the human instructor does not alter the pot settings of the active A-Units, but if the machine errs, the instructor introduces a signal to the active A-Unit motors until the collective output of their pots produces the correct identification.

For a two-object discrimination problem involving "E" and "X," the machine is able to correctly identify the objects 100% of the time after about five exposures. To change the task to one of discriminating between an "A" and a "B," it is only necessary to "brainwash" the A-Units to their original untrained condition and start training the machine again on the new letters. No further action or change is required.

Perceptron Details

The output from each sensor is fed to a number of different A-Units. In the Mark I, there are 40 outputs from each of the 400 sensors which are randomly connected to 512 Association Units. Furthermore each of the 400 sensors (by means of a transistor flip-flop circuit) actually puts out two types of signals whenever it is illuminated by an object. The two signals are identical in magnitude but have opposite polarities.

Thus a single A-Unit in the Mark I may have between 10 and 100 input connections from a variety of sensors. Some carry no signal (if sensor is not illuminated), others carry a signal of positive polarity, still others a signal of negative polarity.

To activate a single A-Unit and connect its output into the Response Unit, the sum of all of the positive and negative input signals, from the many sensors which feed it, must be positive and must exceed a predetermined value. (The value is normally fixed for a set of experiments, but can be changed easily.)

This means that no single A-Unit is activated by the illumination of any single sensor. Instead, its activation depends upon how many and which of

the other sensors in the 20 x 20 matrix are also illuminated. This is one of the novel characteristics of the CAL Perceptron that distinguishes it from a digital computer which has been programed to read letters or identify different symbols by measuring their dimensions and/or angles and comparing these with mathematical expressions stored in the computer's memory.

Unpredictable Reaction

Although the Mark I Perceptron is a relatively simple machine compared with some of today's modern digital computers, its completely random "rat's nest" of interconnections between sensors and A-Units makes it impractical if not impossible to precisely predict in advance how the machine will react to certain types of problems, whereas the response of the most complex digital computer is easily predicted—providing it does not malfunction.

For this reason, it frequently is easier and quicker to subject the Perceptron to a problem and observe its reactions, or simulate Perceptron operation on a digital computer, than to try to predict its reactions by analysis.

In at least one instance, the Mark I was able to provide support for an important theoretical conjecture which had not yet been proven mathematically, according to Dr. Rosenblatt. This conjecture, now a rigorous theorem, is that the Perceptron can always be trained to achieve 100% performance on any classification problem if the machine has sufficient capacity, i.e. A-Units.

The usefulness of the Perceptron in solving military reconnaissance and industrial tasks depends in part upon the development of new types of Association Units which are small enough and

Perceptron Activity

Growing numbers of universities, laboratories and companies are engaged in research or development in the field of Perceptrons, or cognitive machines, which exhibit the ability to learn. In addition to Cornell Aeronautical Laboratory, where the concept started, Office of Naval Research is sponsoring programs at University of Chicago, University of Illinois, University of Michigan, McGill University, Syracuse University, Stanford University and Stanford Research Institute and the Burden Neurological Institute in England. Joint service-sponsored programs also are under way at Massachusetts Institute of Technology and Lincoln Laboratory. Among companies known to be active in the field are Aeronutronic, General Electric, International Business Machines Corp. and Litton Industries. National Bureau of Standards also is engaged in Perceptron work.

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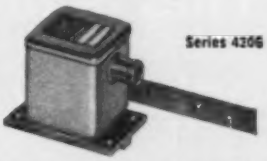

Series 4206

For increased Accuracy to 1% or less under rugged environmental conditions. Originally designed for use in an anti-missile missile, this unit features temperature compensated damping mechanism using silicon fluid.

Pacific's family of accelerometers are designed, developed and tested to meet almost any acceleration measurement requirement. Their custom design provides excellent reliability and accuracy for many critical applications – combining features of lightness with high precision characteristics.

To save you time and money, many of Pacific's accelerometers can be incorporated into your own designs at an early stage.

Each of the basic models illustrated at the right is representative of a series of similar units which vary only in output characteristics. They are available and were developed to satisfy a special requirement but can now be considered as standard production items...completely tooled, qualified, proved in actual use ...ready for immediate order.

For complete information on a Pacific accelerometer designed to your own requirements ... or on a modification of these units, WRITE TODAY. The engineering skill and creative ability of Pacific Scientific are at your service.

Series 4201

Light and little ... This miniature accelerometer is a versatile, high production instrument with unusual flexibility of design and performance characteristics. Maintains accurate signals thru long service life. Potentiometer pick-off.

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This is the only way to judge the true speed of business aircraft

You can leave your office in Detroit, 9:05 A.M....

It's door-to-door elapsed time that counts. The Gulfstream speed, rate of climb, short field capability, and elimination of waiting periods for battery carts, stairways, and other ground-handling equipment drastically reduce door-to-door time. This is the only measure of true speed. And it's these features that enable the extraordinary new corporate turbo-prop — the Gulfstream —to leave many business planes behind.

The Gulfstream can take-off and land on 3,500 foot runways. This means your company can use more than 1,500 airports in the U.S. and Canada . . . to bring you closer to your departure and arrival points. This is part of true speed. The Gulfstream has a self-contained access stairway. Engines start on their own power. You are completely independent of airport ground crew and ground handling equipment. This time saving is also part of true speed. Add to that the Gulfstream's exceptional rate of climb. And a cruising speed of 350 mph at 25,000 feet . . . and even higher altitudes, in pressurized comfort. In other words, the Gulfstream delivers optimum door-to-door performance.

How does the Gulfstream performance compare to piston type aircraft and to pure jets? Our distributors will be happy to give you complete information and detailed specifications, and also arrange a practical demonstration of the aircraft.

board the Gulfstream in downtown Detroit airport . . .

and be in your Washington, D.C., office at 10:55 A.M.

GRUMMAN

AIRCRAFT ENGINEERING CORPORATION

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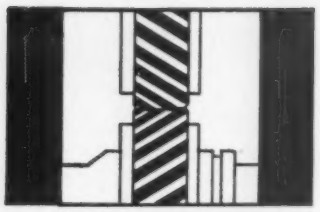
Corporation executives and pilots are invited to inspect the Gulfstream and arrange for demonstration flights through one of the following distributors: Atlantic Aviation, Wilmington, Delaware; Pacific Airmotive, Burbank, Cal.; Southwest Airmotive, Dallas, Texas; Timmins Aviation, Ltd., Montreal, Canada.



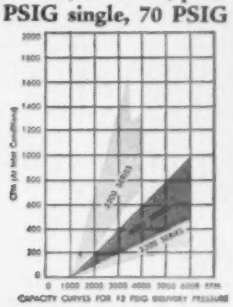
HELICAL GEARS

Every M-D blower shipped has a matched pair of crown-shaved, lapped helical gears. Backlash tolerance is .0005" to .0015". No other blower matches M-D quality.

WHY M-D ROTARY POSITIVE BLOWERS develop higher pressures!

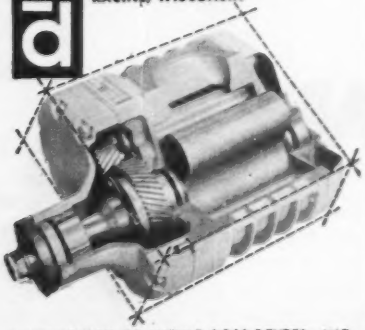
The unique combination of precision manufacture and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower initial cost.

M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 50 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



CAPACITY CURVES FOR 12 PSIG DELIVERY PRESSURE

M-D BLOWERS, INC.
RACINE, WISCONSIN



A SUBSIDIARY OF MIEHLE-GOSS-DEXTER, INC.

cheap enough to permit the construction of machines with hundreds of thousands of A-Units. Also needed is the development of more sophisticated concepts for interconnecting A-Units and the sensors.

The Office of Naval Research is sponsoring the development of miniature magnetic equivalents of the Mark I's motor-driven A-Units at Aeronutronic Division of Ford Motor Co., according to Dr. Marshall C. Yovits, head of ONR's Information Systems Branch. Aeronutronic last week announced the development of such a unit, a doughnut-shaped device about one-quarter the size of a penny. It consists of a magnetic core with an inner hole through which signal wires pass. Core is capped with a metal wash and again wound with wires. Company calls the device MIND—Magnetic Integrator Neuron Duplicator. General Electric also is working on synthetic neurons under sponsorship of Wright Air Development Division.

ARC FUSION PROCESS developed by Linde Co., division of Union Carbide Corp., is used to grow single crystals of refractory metals. Method may permit wider use of these materials in structural and avionic applications. Here a cylindrical crystal of pure tungsten is mounted in a lathe to be turned to a specified diameter.

Single Crystals of Metals Grown

Linde Co., a division of Union Carbide Corp., has developed an arc fusion process for growing single crystals of refractory metals that is expected to enhance significantly use of the materials in avionic and structural applications.

To date, Linde scientists have grown single crystals of tungsten, molybdenum, vanadium, columbium, tantalum, titanium monoxide, titanium sesquioxide, titanium carbide and molybdenum disilicide. In the near future, the company expects to make available single crystals of columbium carbide, vanadium sesquioxide, titanium diboride and tungsten disilicide.

The crystals are produced as cylinders and are available in sizes up to ¾ in. in diameter and to 12 in. in length. Linde scientists are currently working toward the production of single crystals in larger sizes, different shapes and of other materials. Samples of the nine materials now available are being offered by the company at $90 each.

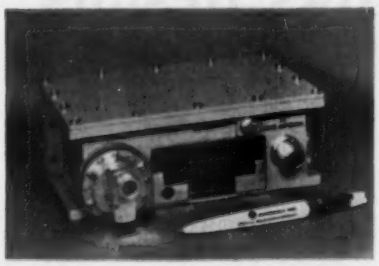
Compared with their polycrystalline counterparts, the single crystals gen-

erally offer significantly higher ductility, a more homogeneous structure of higher purity and greater ease of fabrication. Most important, Linde says, its single crystals can be formed and worked at temperatures significantly lower than those normally required by the refractory group of materials. For instance, threads can be tapped into single crystal tungsten bolts without cracking.

NEW AVIONIC PRODUCTS

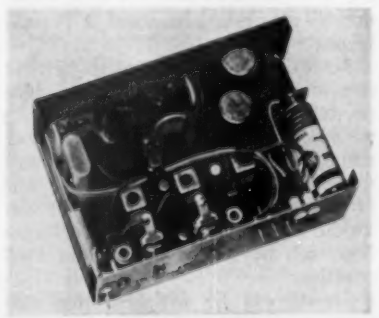
Radio Equipment

• **Radar transponders,** type SST-101 and SST-102, are available for tracking and range instrumentation applications. Type SST-101 (shown) is a general purpose, crystal-video transponder intended for tracking intermediate range missiles, drones and piloted aircraft and includes complete circuit transistorization (except for magnetron) an all solid-state



modulator, volume of less than 75 cu. in. and weight of 4 lb. Type SST-102 was developed for long-range missile tracking and is a general purpose superhet pulse transponder intended for use with precision C-band tracking radars and employs an all-solid state modulator switch, ferrite circulator, high frequency mesa transistors. Motorola Military Electronics Division, 8201 East McDowell Rd., Scottsdale, Ariz.

• **Command receiver,** Model TRR-1263, is a completely transistorized, crystal-controlled, fixed tuned receiver designed to operate over 5 mc. to 16 mc. range and may be used in telemetering, range safety and missile command destruct applications. An integral



multi-tone decoder section provides high immunity from interference, according to the manufacturer, Leell, Inc., 380 Oak St., Copiague, N. Y.

• **Single-Sideband Exciter/Driver,** Model SSB-58-1A, for high level AM ground station transmitters is available. It is based on class C sideband amplification and is designed for use with existing AM and CW transmitters, as well as new AM transmitters. Among the advantages, according to the manufacturer, are relative insensitivity to varying antenna loads and tuning errors, improved undesired sideband rejection at higher power levels. Single or two independent 6-kc. sidebands are developed for use with doppler-free multi-channel FSK teletype, data, voice and facsimile transmissions. Operating frequency range is one to 30 mc. Compact, transistorized systems for low-power AM aircraft or shipboard transmitters are also available. Kahn Research Laboratories, Inc., 81 South Bergen Pl., Freeport, N. Y.

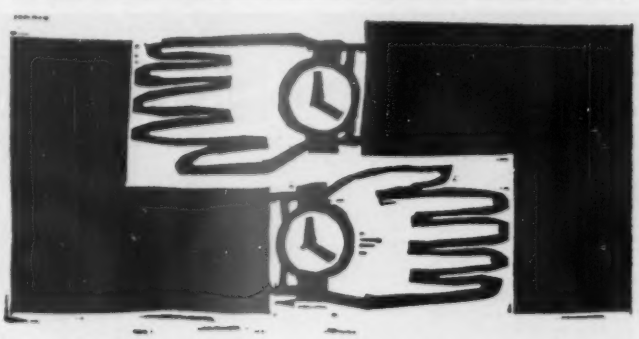
Component & Devices

• **Inverter,** Model KB, is a solid-state device which converts d.c. to 400 cps sine wave from a 28 v.d.c. source and will deliver up to 55 volt-amperes with less than 2% total harmonic distortion. Unit measures 2½ in. x 4 in. x 2½ in. and is encapsulated in moisture-resistant thermosetting foam and meets MIL-

E-5272C specs for moisture, shock and vibration. Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

• **Ferrites,** electrically variable attenuator, Model TFA-1, electrically variable phase shifter, Model TFP-1, and circulator, model TFC-1, comprise line of C-band units which have among them such features as broad bandwidth, low insertion loss, wide temperature range, small size and low weight. Typical of these ferrites is the phase shifter which provides a phase shift range from zero to 90 deg. over a 5.2 to 5.8 kmc. bandwidth, has less than 1 db. insertion loss with a vswr of less than 1.2. Electron Tube Products, Red Bank Division, The Bendix Corp., Eatontown, N. J.

PROBLEMATICAL RECREATIONS 21



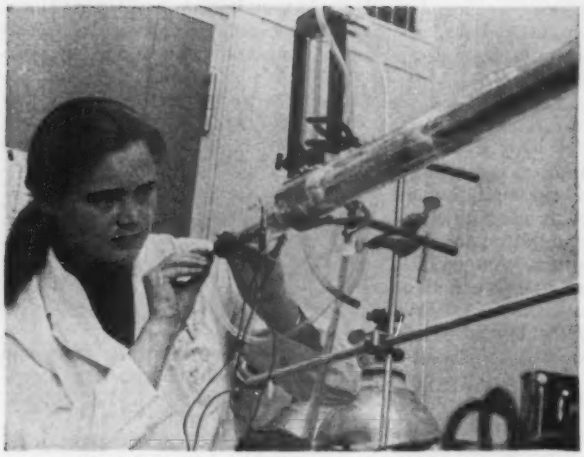
By my watch, the hour and minute hand of your watch coincide every 65 minutes exactly. (A) How inaccurate is your watch? (B) in how many hours will your watch gain or lose an hour?

—The Rochester Indicator

Our Westrex Corporation has equipment you can buy off the shelf: facsimile continuous recorders, multi-channel data recorders, and single sideband transmitters and receivers. They also have a powerful capability in R&D which you might utilize.

ANSWER TO LAST WEEK'S PROBLEM: A thoroughly inbred family—the physicist not only married his cousin, but so did his brother and his sister—resulting in a party of two, including the host.

LITTON INDUSTRIES
Beverly Hills, California



OPEN TUBE FURNACE employed in vapor growth process by which semiconductor devices can be grown continuously in a single operation is unloaded (left) at the Research Laboratory of International Business Machines Corp. in Poughkeepsie. Leads for "or not" circuit composed of 17 layers of thin passive films and chip transistors are thermo-compression bonded (right) to glass substrate at Federal Systems Division of IBM in Kingston, N. Y.

IBM Thin Film Program Shows Results

By Barry Miller

Kingston, N. Y.—First results of a research and development program aimed at providing a broad range of thin film circuit functions for future military electronic systems were demonstrated here recently in the laboratories of the Federal Systems Division of International Business Machines Corp.

Sponsored by the Army Signal Corps under an initial contract of about $190,000, the program will complete its first year at the end of this month, at which time a contract extension now being negotiated will be awarded to the firm, according to a Signal Corps representative. IBM's over-all thin film program, however, both here and at the company's Research Laboratory in Poughkeepsie, is far more extensive and involves more people and equipment than the dollar value of the Army's contract implies.

Thin films have come to be regarded as the ultimate step in the trend toward diminutive, reliable and automatically produced electronic systems.

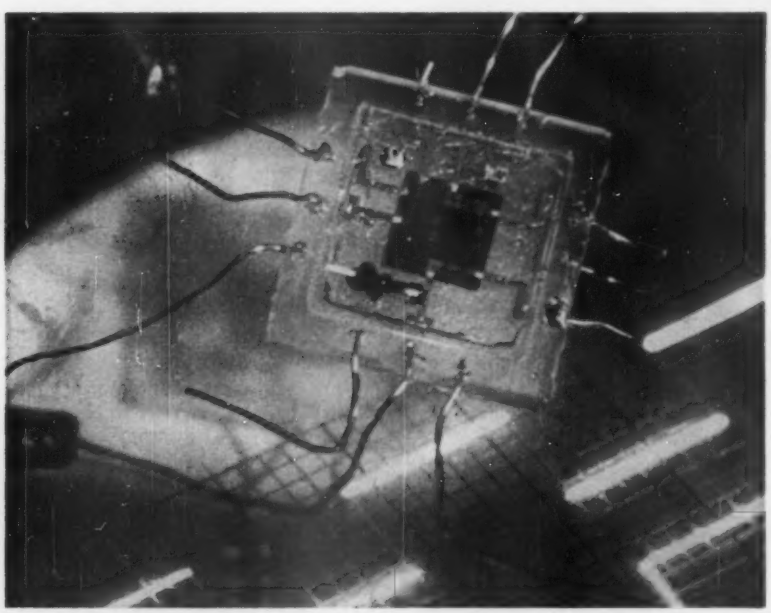
The Army-IBM thin film program is attempting to:

- **Demonstrate the feasibility** of depositing multiple layers of thin films—one atop the other—so as to synthesize a complete circuit of passive elements.
- **Grow thin single crystalline layers** of semiconductors with controlled electrical and physical characteristics for active circuit functions.
- **Develop experimental models** of six common circuits—audio, IF and RF amplifiers, astable multivibrator, transistor-resistor-logic *nor* and *or not* circuits using thin passive films and uncased, surface-passivated transistors.

Toward the second goal, the company demonstrated its technique of growing thin films from a vapor epitaxially—that is, continuously from the same seed so that crystal orientation of one film coincides with the next. This work is progressing here and at Poughkeepsie.

Potential advantages cited by the company for its crystal growing process, called vapor growth, are:

- **Fabrication of the active** part of a semiconductor device such as a transistor, four-layer diode or Esaki diode in a single operation. Growth of the crystal, doping and formation of junctions can be carried out in the final container.
- **Growth can be switched** from one



THIN FILMS, 17 layers in depth, comprise passive portions of "or not" circuit made for Army Signal Corps and shown here. Films are located in darkened center square which is 0.3 in. on a side, the size of an Army micromodule wafer. Surface-passivated transistors and diodes are bonded on outer portion of the glass substrate. Thickness of substrate and film layers totals 280 micro-inches.

semiconductor to another to form heterojunctions—germanium on gallium arsenide or silicon on gallium phosphide, for example, thereby tailoring the final device to use advantageous properties of both materials.

• **Preparation of arbitrary** spatial impurity distributions because the growth process is conducted at temperatures where impurity movement is negligible.

As part of its over-all corporate thin film program, IBM fabricated some experimental transistors by vapor growth but, the company concedes, their quality does not yet measure up to alloyed and diffused transistors. The difficulty thus far is in doping in the emitter region and getting proper injection efficiencies.

While vapor growth research with germanium and gallium arsenide are being pressed at Poughkeepsie, work in this laboratory has centered around silicon for the Signal Corps program. The development has not reached the device stage here, but is concentrated on studies of properties and characteristics of vapor grown junctions. IBM engineers speak of eventually building arrays of active devices on small area semiconductor substrates. These could be made, they say, by growing one semiconductor layer on a channeled substrate, then lapping the surface smooth, thermally oxidizing the surface and finally diffusing in opposite conductivity material.

Passive Thin Films

For its Signal Corps program, IBM deposited as many as 17 layers of film on a 0.6 in. square substrate of standard microscope-slide glass. In a typical case, that of an 18 layer or not circuit, all necessary passive films—nichrome for resistors, aluminum for conductors and silicon monoxide for insulators and dielectrics—were masked onto a 0.3 in. square centered in the larger 0.6 in. square substrate. Uncased, surface passivated transistors, of the types made by Fairchild Semiconductor and Pacific Semiconductors, are thermo-compression bonded on the outer perimeter of the substrate, outside the area of the deposited passive components, to complete the functioning circuit. The entire unit is then encapsulated.

Circuits were fabricated on the 0.6 in. square substrate for convenience in demonstrating the multilayer processing. That the passive components are contained in an area the size of an Army micromodule wafer suggests, however, the possibility of housing passive multilayer thin film circuits on a single wafer. Uncased transistors and diodes could then be accommodated in a hybrid micromodule (one containing a mix of conventional and film components) on separate wafers until such time that the firm's epitaxial growth technique or one like it can provide comparable active components on a separate wafer. This would provide the military with a complete film circuit technology for use in the micromodule packaging with active and passive film circuits mounted on separate wafers and interlaced as required.

Multilayering techniques employed by IBM are as follows: Twenty or 40 mil thick substrates without any visible imperfections are selected and put through a rinsing, washing and degreasing process, as are all utensils, glassware, jigs and fixtures, in an effort to minimize bothersome pinhole shorts in completed film circuitry.

Fabication Processes

Fabrication processes differ somewhat, the company explains, depending on the evaporator employed. For one mask changer, the substrates are preprocessed with a 5,000 to 10,000 angstrom silicon monoxide protective undercoating and edge connector lands for bonding external leads. Substrates are then placed in the mask changer where film layers are sequentially deposited without breaking the vacuum After deposition, the films are annealed, removed, microscopically examined and then placed in a circuit substrate holder and cemented into position. External leads are thermo-compression bonded to the film lands and similarly bonded or spot welded to the heavy leads of the holder. Values of circuit elements are checked and active elements are put in position for thermo-compression bonding to their film lands. The circuit is given an operational check and active elements are coated for surface protection. Finally, the substrate holder is surface encapsulated and faced on a lapping table.

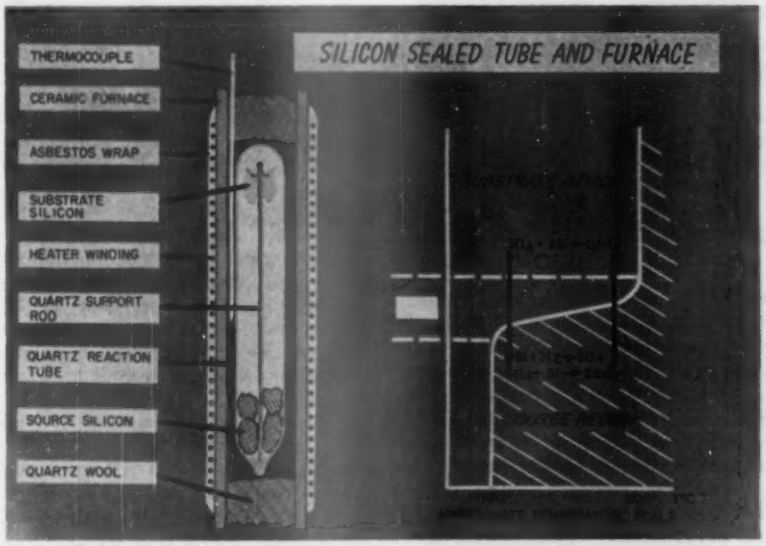
Resistive films are deposited from an extended wire source in 200 ohms/square and in some cases 500 ohms/square. These films are coated with silicon monoxide to protect them from atmospheric effects. Films can be measured on the substrate during deposition in a new mask changer.

The dielectric films are formed of 10-20,000 angstroms thick silicon monoxide and yield 45,000 picofarads per square per micron for a two plate capacitor. Crystal and light transmission monitoring controls dielectric film thickness during deposition.

Aluminum films of 5,000 angstrom thickness are deposited from an extended wire source using aluminum hook loops for the evaporant. Aluminum was selected for the conducting films because a thin layer of surface oxide which forms on the film boosts the yield of pinhole free insulations and the aluminum to gold thermo-compression bond is easy to obtain. Difficulties encountered in depositing high valued inductors limited inductor values employed in experimental circuits to 10 microhenries fabricated in flat 52 turn spiral form on 0.6 square. This limitation could be sidestepped in a micromodule where inductors could be mounted on a separate wafer.

Active Thin Films

Six circuits were fabricated as part of the program. Circuits and number of passive film layers are: or not (two inverter circuits each with base overdrive capacitor and common collector resistor—18; 20-mc. RF amplifier and 4.5-mc. IF amplifiers—12; audio ampli-



THIN SILICON LAYERS are grown epitaxially from vapor phase in evacuated quartz tube 2.5 cm. in diameter and 18 cm. long, located in two-zone furnace. Small quartz hooks support substrates.

fier–13; multivibrator and TRL *nor*–11.

In the company's vapor growth process, a semiconductor halogen vapor picks up the semiconductor at one end of a reaction tube held at a high temperature and then passes it to the other end, kept at a lower temperature, where the semiconductor grows from the vapor onto a single crystal seed. The process can be carried out in an open tube, in which a continuous flow of gas carries vapors in one end and out the other or in a closed tube, as it is done here. Vapors recirculate in the closed tube. Physical configurations of reaction tubes play an important part in the process; consequently IBM engineers are studying a number of different tubes.

Layer by layer growth is made possible by vapor growth, the company points out, because the temperatures of the growth process (500 to 600C for germanium and 800 to 950 for silicon) are lower than melt temperatures and layers are not disturbed by one another. High quality single crystals which compare favorably with crystals grown from melt have been obtained.

Besides previously mentioned potential advantages of this technique, IBM engineers say the process makes possible large area pn junctions desired for solar cells, fabrication of large arrays and growth of different conductivity layers between junctions.

At present, oxides trapped on the junction between the parent material and the grown semiconductor degrade the quality of the substrate-deposit interface. The oxide layers impede uniform nucleation and good crystal growth.

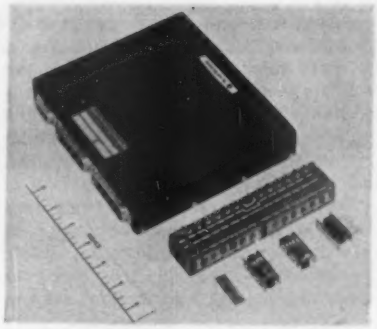
One approach to overcoming this, they say, would be to lap off the substrate and make the device from fully grown junctions.

Like many other companies, IBM is studying surface passivation techniques for active components.

The company also is exploring high ohm/square resistive materials and high k dielectrics as part of its thin film work.

FILTER CENTER

► **"Do-It-Yourself" Micromodules**—Availability of micromodule kits which enable engineers to design and assemble their own micromodule circuits in the laboratory was announced recently by Radio Corp. of America. Priced at $8,000, each kit includes over 50 components mounted on now familiar 0.3 in. square ceramic micromodule wafers, riser wires, air abrader, automatic control device, curing oven, vacuum dust collector, 10 to 20 power stereo zoom lens microscope, parts cabinet, heat sink, encapsulation mount and other equipment, sufficient to build and test 10 complete modules. Kits can be purchased from Radio Corp. of America Semiconductor and Materials Division field offices.



Telemetry Encoder

Miniature Digilock telemetry system encoder, developed by Space Electronics Corp., which will be used in Air Force Journeyman four-stage sounding rocket to measure radiation and other phenomena at altitudes up to 30,000 mi. Complete telemetry system, weighing only 2 lb., will operate for 15 hr. from 1¼ lb. battery supply. Transmitter output is 250 milliwatts. Digilock employs pulse code modulation using orthogonal codes that achieve very high communications efficiency. Bit rate is 64 or 256 per second. Modular construction used in encoder is shown disassembled.

► **Making Transistor Devices Smaller**—CBS Laboratories, Stamford, Conn., hopes to develop new high resolution technique using ion beam and electron beam technology for making microminiature semiconductor junctions. Under $55,000 Signal Corps contract, company believes it can make junction diameters orders of magnitude smaller than 2 mil. High reliability and small transistors could follow.

► **WWV Adds Timing Code**—National Bureau of Standards radio station WWV has added a timing code, on an experimental basis, to its regular broadcasts on 2.5, 5, 10, 15, 20 and 25 mc. frequencies. Broadcast timing code, which indicates the day, hour, minute and second (Universal Time), is accurate to within 0.001 sec. and can be used to synchronize satellite sightings or other observations made at widely separated locations. The code is broadcast for one-minute intervals 10 times each hour. Except at beginning of each hour, code follows immediately after transmission of 440 and 600 cps. audio frequencies. The transmission employs a 36-bit, one-hundred pulse/second binary coded decimal code using a 1,000 cps. carrier. New WWV time-code generator was developed by Electronic Engineering Company of California.

► **Shrinking Transformers**—Sylvania recently disclosed core lamination technique which, it says, permits 2 to 30% reduction in size and weight of transformers. Transformer core consists of two U-shaped nests of steel strips joined together, with strips at top of the U interlaced to form a hollow rectangle. Nested cores permit lines of force to flow with, rather than against, the grain of the steel, thereby reducing the resistance of the magnetic circuit and enabling the transformer to operate as efficiently as heavier, larger, conventional core devices. Company says it has been making transformers with this technique for better than five years at its Ipswich, Mass. plant.

► **Signed On The Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **General Electric,** Heavy Military Electronics Department, Syracuse, N. Y., $14 million from Navy for AN/SPS-30 lightweight 3-D radar which provides target bearing, height and range.

• **Lear, Inc.,** Grand Rapids, Mich., contract from Lockheed Missile and Space Division to produce a digital servo system for controlling tilt and translation of mirror system capable of assuming 200 positions in each of two axes. A memory tape device will provide automatic sequencing and instantaneous readout of all positioning data.

• **Stromberg-Carlson Division,** General Dynamics Corp., $4 million from Navy Bureau of Weapons for special transistorized airborne radio equipment to be used in anti-submarine warfare.

• **Melpar, Inc.,** Falls Church, Va., reports three contracts from USAF's Cambridge Research Center. One covers study to determine feasibility of recognizing vehicles in space or the atmosphere by the characteristics of their paths. Second covers series of meteorological research investigations. Third calls for design and construction of antenna assembly for use in fourth-stage nose cone of Air Force 609A ballistic test missile.

• **Sylvania's Applied Research Laboratory** will study very low frequency radio propagation, including the applicability of very low frequency waveguide mode theory to unexplored areas, under an $87,000 contract from the Office of Naval Research. In addition, the laboratory has been directed by Air Force Cambridge Research Center to study extra low frequency (below 1 kc.) propagation in the upper atmosphere. For this study and three other contracts, Sylvania will receive $153,000.

FINANCIAL

New Offerings

Avnet Electronics Corp., Westbury, N. Y., the company and subsidiaries are engaged in assemblying and distributing a line of electrical connectors and in distributing transistors, diodes, capacitors, transformers and other items related to the electronics, aircraft, missile and communications industries. Offering is $2,000,000 of convertible debentures due 1975, for public sale by the issuing company, and 150,000 outstanding shares of common stock by the present holders thereof. Offering prices, underwriting terms and interest rate on the debentures to be supplied by amendment. Proceeds from the sale of the debentures will be used to repay $600,000 of outstanding short term bank loans; to maintain required inventories of both new product lines and those currently distributed; to stock parts and material necessary to assemble certain electrical testers; to provide additional working capital.

Avnet's president, the board chairman, and the vice president and treasurer are three of the seven selling stockholders; amount of shares to be sold by each to be supplied by amendment.

Lamtex Industries, Inc., Farmingdale, N. Y., engaged in the design, engineering, development and manufacture of fiber glass-reinforced plastic components and assemblies which are principally used in missiles, rockets, airplanes, radar sets, sonar sets, torpedoes, electronic and heavy electrical equipment. Offering is 100,000 shares of common stock, for public sale at $5 per share. Of the proceeds, $60,000 will be used to increase the company's sales effort; $40,000 for further research and development on proprietary products, which are now in the development stage; $50,000 to purchase additional machinery and equipment; $100,000 to repay a bank loan; $26,119 to repay loans from stockholders; the balance for working capital.

Navigation Computer Corp., Philadelphia, Pa., engaged in the manufacture and sale of special purpose digital computers and a catalogued line of transistorized digital systems modules for use in various industrial, commercial and military applications. Offering is 50,709 shares of common stock, for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, the company contemplates the expenditure of some $120,000 for a new plant to be constructed near Valley Forge, Pa., at an estimated cost of $275,000; the balance of such cost to be provided through mortgage financing. The balance of the funds will be used for the purchase of additional equipment ($18,000), and for working capital purposes.

Amoux Corp., Los Angeles, Calif., engaged in designing, developing, manufacturing and selling electrical and electronic instruments and components as well as electronic systems and subsystems for use in various military, industrial and scientific installations; a subsidiary designs and manufactures multi-contact and environmental electric connectors. Offering is 133,000 common shares for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $150,000 will be applied to the repayment of loans in that amount from certain shareholders; $225,000 for expansion of the company's engineering and manufacturing capacity in the field of power supplies; $150,000 for expansion of the subsidiary's manufacturing capacity in the field of special purpose electrical connectors; $100,000 for design, development and increased manufacturing capacity in the field of temperature measurement and control equipment; $200,000 to finance raw

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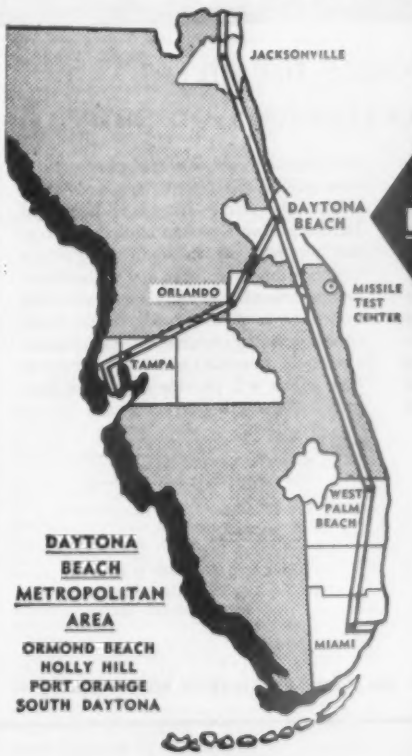

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material and work in process inventories; $64,000 to finance the purchase of 51% of the outstanding stock of Astra Technical Instrument Corp.; the balance for working capital.

Varian Associates, Palo Alto, Calif., principally engaged in the design, manufacture and sale of microwave tubes, electronic instruments, vacuum equipment and electronic systems and components for military, commercial and industrial use. Offering is 216,645 shares of capital stock, for subscription by stockholders of record July 14, 1960, at the rate of one new share for each 15 shares then held; subscription price and underwriting terms to be supplied by amendment. Of the proceeds, about $2,500,000 will be used in the company's building construction program at Palo Alto; $2,000,000 for the purchase of machinery and equipment required for fabrication and processing of high-power klystron tubes; $1,700,000 for the purchase of other machinery and equipment to expand productive capacity in other product areas; $1,300,000 to retire outstanding bank borrowings; the balance for working capital purposes.

Astrotherm Corp., Indianapolis, Ind., engaged in the designing, engineering and manufacturing, for both military and commercial application, of proprietary and non-proprietary aircraft and missile components and assemblies. The company was organized under Delaware law in March, 1960, as successor by merger, effective May 16, 1960, to the business and property of Monument Engineering Co., Inc.

Offering is $308,000 of 8% subordinated convertible debentures due July, 1970, 154,000 common shares, and 46,200 common stock purchase warrants, to be offered in units (3,080) at $200 per unit, each consisting of $100 principal amount of debentures, 50 common shares, and 15 warrants (exercisable initially at $2 per share). Of the proceeds, $195,000 will be used to repay loans from Mercantile Discount Corp.; $56,000 to repay loans from management officials and principal stockholders; $60,000 for additional laboratory and test equipment; the balance for working capital purposes.

Associated Testing Laboratories, Inc., Caldwell, N. J., engaged in the business of environmental testing of components for defense industry; the company also manufactures environmental test equipment for use in its own operations and for sale to others. Offering is 75,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. A portion of the proceeds will be used initially to retire $100,000 of short term bank loans incurred for working capital purposes, and to provide additional testing facilities and equipment in new plants at Wayne, N. J., and Winter Park, Fla.; the balance will be added to working capital, and is expected to be used in part for further expansion of facilities, including the possible establishment of new testing laboratories in the New England and West Coast areas (in each case at an estimated cost of $125,000).

Kings Electronics Co., Inc., Tuckahoe, N. Y., engaged in the design, development and manufacture of radio frequency coaxial connectors, electronic testing equipment, aircraft intercommunication systems and components and other electronic equipment. Offering is 200,000 shares of common stock and 100,000 common stock purchase warrants, to be offered for public sale in units, each consisting of one share of common stock and one-half common stock purchase warrant, at $4 per unit. Of the proceeds, $165,000 will be applied to the repayment of certain loans; $75,000 for development and design work by a subsidiary in the field of infrared instrumentation; $100,000 for continued research in the design, development and production of components for microwave instruments; the balance for working capital.

A New Name for an Outstanding Electronics Company

Standard Kollsman Industries Inc. is the new corporate title adopted by Standard Coil Products Co. Inc., for many years a familiar name among leading industrial corporations.

The new name combines "Standard," the world-wide symbol for original research and quality in the design and production of television tuners, with "Kollsman," which has been synonymous over the years with leadership in instruments, components and systems for aviation and celestial guidance systems for aviation, guided missiles and space vehicles.

The new name—Standard Kollsman Industries Inc.—recognizes the substantial progress of Kollsman Instrument Corporation, the principal subsidiary, and portrays the parent company's rapid expansion in its own fields. At the same time it reflects diversification into related electronic, electrical and consumer products which will provide a broader base for future growth.

Subsidiaries of the company are:

Kollsman Instrument Corporation
Elmhurst and Syosset, New York
Glendale, California

Kollsman Luftfahrt Instrumente, G.m.b.H.
Munich, West Germany

Richardson-Allen Corporation
College Point, New York

Kollsman Motor Corporation
Dublin, Pennsylvania

Standard Coil Products (Canada) Limited
Toronto, Canada

Standard Kollsman is listed on the New York Stock Exchange; New ticker symbol—SKO.

standard kollsman INDUSTRIES INC. 2085 NORTH HAWTHORNE AVENUE, MELROSE PARK, ILLINOIS

Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Holdings for the period Apr. 11 to May 10, 1960, reported the following transactions:

Temco Aircraft Corp. Acquisition of 500 common shares by Clyde E. Skeen, officer and director, making a holding of 500.

Texas Instruments. Disposition of 100 common shares by W. D. Coursey, officer, leaving a holding of 5,845; disposition of 3,000 common shares by W. F. Joyce, officer, leaving a holding of 8,262; disposition of 500 common shares by C. J. Thomsen, officer and director, leaving a holding of 11,638; disposition of 400 common shares by E. O. Vetter, officer, leaving a holding of 7,388.

Thiokol Chemical Corp. Disposition of 500 common shares by H. R. Ferguson, director, leaving a holding of 28,936; disposition of 4,000 common shares by Robert Lang, director, leaving a holding of 325,912.

Thompson Ramo Wooldridge, Inc. Disposition of 3,000 common shares by Archie T. Colwell, officer and director, leaving a holding of 10,000; disposition of 200 common shares by Harold L. George, director, leaving a holding of 33,735.

Western Air Lines, Inc. Acquisition of 281 common shares through exercise of rights by C. J. Cox, officer, making a holding of 1,684; acquisition of 480 common shares through exercise of rights by Hugh W. Darling, director, making a holding of 3,000; acquisition of 247 common shares through exercise of rights by Terrell C. Drinkwater, officer and director, making a holding of 7,000; acquisition of 300 common shares (240 shares through exercise of rights) by Robert E. Driscoll, director, making a holding of 1,500; acquisition of 226 common shares through exercise of rights by Goodrich Lowry, director, making a holding of 1,356; acquisition of 4,770 common shares through exercise of rights by Dudley Swim, director, making a holding of 28,616; acquisition of 323 common shares through exercise of rights by J. J. Taylor, officer and director, making a holding of 2,900; acquisition of 492 common shares through exercise of rights by Harry J. Volk, director, making a holding of 2,900; acquisition of 700 common shares by Sidney F. Woodbury, officer and director, making a holding of 857.

Transactions reported during the period from Mar. 11 to Apr. 10, 1960 included:

Allegheny Airlines, Inc. Acquisition of 300 common shares by David L. Miller, officer, making a holding of 502; acquisition of $2,500 of 6½% convertible debentures by David L. Miller, officer, making a holding of $2,500; acquisition of $10,000 of convertible debentures by Philip V. Mattes, director, making a holding of $10,000.

Ampex Corp. Disposition of 3,990 common shares by T. Kevin Mallen, director, leaving a holding of 55,500; disposition of 10,000 common shares by Henry A. McMicking, officer and director, leaving a holding of 67,235; disposition (by private sales) of 195,000 common shares held in trust, his total indirect holding, by Joseph R. McMicking, officer and director (direct holding remains 450,000); acquisition of 1,500 common shares by Walter T. Selsted, officer, making a holding of 2,625.

Beech Aircraft Corp. Disposition of 2,000 common shares by Olive Ann Beech, officer, director and beneficial owner, leaving a holding of 79,738 (indirect holding remains 65,212); disposition of 9,996 common shares by John P. Gaty, officer, leaving a holding of 2,000; acquisition of 300 common shares through exercise of option by Michael G. Neuburger, officer, and disposition of 300 common shares, leaving a holding of 1,237.

Bendix Aviation Corp. Acquisition of 397 common shares by Roy H. Isaacs, officer, making a holding of 1,634; disposition of 651 common shares, his total holding, by Palmer Nicholls, officer.

California Eastern Aviation. Disposition of 1,300 common shares by Edward A. Kerbs, director, leaving a holding of 4,610.

Combustion Engineering. Acquisition of 500 common shares by William H. Draper, Jr., director, making a holding of 500.

Curtiss-Wright Corp. Disposition of 100 common shares, his total holding, by Nicholas Dykstra, officer; disposition of 2,400 common shares by S. B. Kurzina, Jr., officer, leaving a holding of 2,400.

Douglas Aircraft Co., Inc. Disposition of 8,000 capital shares by Arthur E. Raymond, officer and director, leaving a holding of 1,000.

Flying Tiger Line, Inc. Disposition of 102 common shares by Ruth H. Axe, director, leaving a holding of 1,000; disposition of 500 common shares, his total holding, by Leonard S. Kimball, officer.

General Dynamics Corp. Disposition of 1,000 common shares by Vernon M. Welsh, officer, leaving a holding of 8,000.

General Electric Co. Acquisition of 1,512 common shares through exercise of option by George L. Irvine, officer, making a holding of 6,395; disposition of 1,185 common shares by Gerald L. Phillippe, officer, leaving a holding of 7,427 (indirect holding remains 750); disposition of 1,166 common shares by Charles K. Rieger, officer, leaving a holding of 5,825; disposition of 400 comman shares by Harold E. Strang, officer, leaving a holding of 7,450; disposition of 1,124 common shares by Arthur F. Vinson, officer, leaving a holding of 10,731 (indirect holding remains 465); disposition of 1,000 common shares by Glenn B. Warren, officer, leaving a holding of 9,331.

General Precision Equipment. Disposition of 2,000 common shares by Edwin A. Link, director, leaving a holding of 36,811; acquisition of 5,900 common shares by The Martin Co., making a holding of 192,400.

Lear, Inc. Acquisition of 134 common shares, bonus, by Harold C. Andrus, officer, making a holding of 1,357; acquisition of 177 common shares, bonus, by Roy J. Benecchi, officer and director, making a holding of 2,166; acquisition of 157 common shares, bonus, by Albus Durham, officer, making a holding of 1,122; acquisition of 223 common shares, bonus, by Philip E. Golde, officer and director, making a holding of 4,327; acquisition of 107 common shares, bonus, by T. K. Greenlee, officer, making a holding of 2,006; acquisition of 194 common shares, bonus, by Andrew F. Haiduck, officer, making a holding of 194; acquisition of 23,293 common shares (493 shares as bonus) by William P. Lear, director and beneficial owner, making a holding of 446,060 (sale of 30,000 shares in Dec. 1959 was reported in error); acquisition of 277 common shares, bonus, by Richard M. Mock, director, making a holding of 11,310; acquisition of 100 common shares, bonus, by Joseph M. Walsh, officer, and disposition of 523 common shares, leaving a holding of 100.

Litton Industries, Inc. Disposition of 1,000 common shares by Glen McDaniel, officer, leaving a holding of 18,000.

The Martin Co. Disposition of 601 capital shares by Howard W. Merrill, officer, leaving a holding of 1,447.

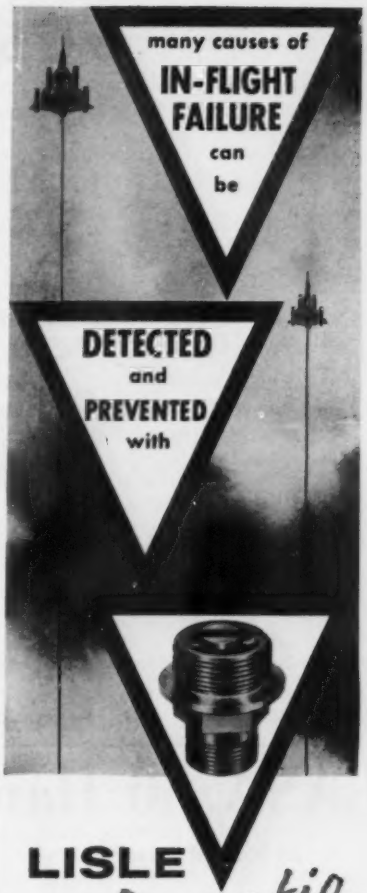
McDonnell Aircraft Corp. Disposition of 200 common shares by Kendall Perkins, officer and director, leaving a holding of 696.

Mohawk Airlines, Inc. Disposition (redeemed) of $100,000 of 5½% convertible debentures, the total holding, by Co-op Grange League Federation Exchange, beneficial owner; disposition (redeemed) of $4,000 of 5½% convertible debentures, his total holdings, by William J. Fields, director; disposition (conversion) of $125,000 of 5½% convertible debentures, his total holding, by Edwin A. Link, director, and acquisition of $125,000 of 6% convertible debentures, making a holding of $125,000.

Resistoflex Corp. Acquisition of 1,445 common shares by Joseph M. Gentile, officer and director, making a holding of 3,164.

Rohr Aircraft Corp. Disposition of 600 common shares by Guy M. Harrington, officer, leaving a holding of 160.

Seaboard & Western Airlines, Inc. Disposition of 1,000 common shares by Carol D. Brell, officer, leaving a holding of 30,103; disposition of 3,100 common by Arthur V. Norden, officer, leaving a holding of 28,782.



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LOCKHEED-AZCARATE Model 60 light utility plane is powered by a 250-hp. Continental fuel injection IO-470-G engine.

Aviation Week Pilot Report:

LASA 60 Handles Well in All Regimes

By Richard Sweeney

Los Angeles—Straightforward handling in all flight regimes characterizes the Lockheed-Azcarate Model 60 light utility plane, paralleling the aircraft's uncomplicated design and workhorse mission.

Main points of the plane's qualities demonstrated during an AVIATION WEEK flight evaluation included:

- **High degree** of static and dynamic stability.
- **Medium control pressures** coupled with good response rates to control displacement.
- **Good short takeoff** and landing characteristics.

Aircraft flown was XB-GUZ, first LASA 60 prototype, which was certificated with the 250-hp. Continental fuel injection IO-470-G powerplant (AW Apr. 25, p. 95). The plane is registered to Lockheed-Azcarate at San Luis Potosi, Mexico. Col. Alfonso Gandarilla, chief pilot for Lockheed-Azcarate, was piloting the airplane during its tour of southern California.

A key element in the LASA 60 high-performance landing and takeoff ability is the Fowler-type flaps. In keeping with the simplicity of LASA 60 design, these have direct mechanical linkage rather than hydraulic actuation, with an overhead handle in the cockpit connected to cables, push-pull tubes and scissor-jointed rods to move the surfaces along the tracks.

On the prototype, the flap actuating handle is rather long and swings through a wide arc. The handle is near the windshield center post with flaps up, and moves through a wide arc to behind the pilot's shoulder for flap full-down position. On this airplane, three positions are used—full up, 15 deg. (takeoff) and 27 deg. (full down, landing). It is planned, on production planes, to shorten the handle, which is awkward to move to the last stop in the prototype, and also to add another stop in flap travel between the 15 and 27 deg. positions.

The flight evaluation was performed at Van Nuys Airport, 700 ft. mean sea level elevation, with surface temperature approximating 90F. Altimeter setting was 29.94, and the aircraft was at medium gross weight for takeoff, about 2,800 lb.

High-Performance Takeoff

The first high performance takeoff was performed by Col. Gandarilla, who lifted the aircraft off the runway after about a 600-ft. run at just over 50 mph. indicated airspeed, using 15 deg. flap. A high-performance landing by Gandarilla, using full flaps and no power, was made with an approach angle of about 15 deg. A full stop was reached within about 400 ft. after touchdown.

First takeoff by the AVIATION WEEK pilot was normal, without flaps, with the aircraft lifted off at about 70 mph. IAS. With the 250-hp. engine, the aircraft's rate of climb is not spectacular; however, a considerable improvement should result from using the 260-hp. supercharged engine which retains its power during climb.

Landings included one high-performance 360-deg. overhead approach, using full flaps from the initial point. The airplane was flared using some power. Braking after touchdown was efficient, and the steerable nosewheel kept the aircraft straight on the runway despite an occasional crosswind gust.

For the LASA 60, the best rate-of-climb speeds vary according to gross weight and altitude, ranging from 85 mph. IAS at sea level to 65 mph. IAS at 18,500 ft. mean sea-level altitude. Best angle is obtained by raising the nose until minimum speed is obtained with flaps at takeoff setting, keeping power at maximum continuous.

Normal approach speed is in the order of 90 mph. IAS, but use of flaps and power can be tailored to achieve the desired flight path such as a steep angle or flat approach.

One feature of the LASA 60 design is its swept-back, tapered steel tube main landing gear struts with rubber shock absorbers rather than conventional air-oil struts. Dropping the LASA 60 onto

the ground from several feet produces almost as soft a landing as "painting it on," and the gear configuration does not bounce the plane back into the air. Once on the ground, the aircraft stays there, with immediate and excellent brake effectiveness.

In level flight the aircraft displays good characteristics about both longitudinal and lateral axes. Induced oscillations in pitch axis from trimmed cruise condition show the aircraft to have a long period with small altitude changes and a tendency to damp out the oscillation in less than three complete cycles.

In trimmed-out turns, rudder-induced oscillations showed the high degree of stability, with the aircraft tending to return to trimmed-out condition in few oscillations.

Slow flight, using flaps in takeoff position, demonstrated good stability characteristics until the bottom edge of the speed envelope was reached, about 52 mph. IAS at 4,200 ft. MSL altitude. At the extreme low speeds, the aircraft tends to be wobbly, but adding a few miles per hour restores normal control effectiveness. The aircraft should be efficient in slow approaches to landing in mountainous, isolated areas such as are planned for South American operations.

In using flaps, both after takeoff and in slow flight, care is required in raising the lift devices. A pronounced sink results when the surfaces are retracted, due to their high efficiency.

Stall investigation showed the plane to have good characteristics. In a normal power-off situation, unless full nose-up trim is applied in level flight, the airplane tends more to run out of elevator and finally develop a negative rate of climb without significant buffet, rather than a clear shudder, break and fall. A definite break can be felt in the power-off straightaway pattern if the nose is raised to a high angle.

In using power, flaps, or combinations of power and flaps in stalls, the airplane again shows a tendency to develop a sloppy elevator condition even with full nose-up displacement, and assumes a negative rate of climb.

Using high power, flaps and steep turn, the plane will shudder and require heavy control pressures to retain the attitude, but shows no tendency to snap out suddenly. Steep turns with high power settings and full flaps produce a definitely tight turn, but again full elevator displacement results in a continuation of the shuddering progress around the turn.

Sensitive Rudder

In all flight regimes the airplane has a very sensitive rudder, but its effectiveness varies with airplane configuration and flight condition. There appears to be no significant blanking of the surface when flaps are full down, speed is low and a tight turn assumed, although effectiveness diminishes and pressure required for high displacement stays medium to heavy.

The airplane does not incorporate a rudder trim, which has good and bad aspects. On the positive side is reduced complexity of the general airframe, while on the negative side is the necessity to develop the footwork as a function of flight speed and power setting. This should not be difficult for pilots who spend high amounts of time flying the airplane in the bush.

External appearance makes the LASA 60 look short-coupled, but the general controllability and response rate disavow the appearance. The visual impression probably results from the plane's deep fuselage extending farther aft than usual, as a design feature enabling the ship to carry cargo which may be bulkier than it is heavy.

Cockpit of the prototype XB-GUZ is well laid out, except for the flap actuating handle mentioned earlier. The aircraft is not equipped for all-weather flight; in fact, radio provisions are "as required and desired" for individual customers.

Powerplant controls are grouped in the lower center of the panel. They are all of the vernier type and include throttle, propeller and fuel pressure (or mixture, since this is a fuel injection engine).

The key-operated ignition switch is on the upper left corner of the instrument panel, with direct-drive starter switch just below it and covered by a guard when not in use. The standard flight instrument group is in front of the pilot and includes airspeed indicator, altimeter, electric turn and bank, and vertical rate gage.

Powerplant instruments are located on the panel center, and include tach-

LASA 60 flap-actuating handle can be seen through windshield, near center post. Note large size of opened cargo door.

Civil Aircraft Engine Shipments

Shipments by Plants Manufacturing Complete Civilian Aircraft and Engines for Civilian Aircraft

Item		April 1960	Cumulative totals Jan.-April 1960
Complete aircraft, total airframe weight	1,000 lb	2,662.6	9,760.1
By weight of plane:			
Under 3,000 lb. airframe weight	do	764.7	3,241.7
3,000 lb. airframe weight and over	do	1,897.9	6,518.4
By number of places:			
1- and 2-place	do	717.5	3,002.1
3- and 5-place	do		
Over 5-place	do	1,945.1	6,758.0
By total rated horsepower, all engines:			
Under 100 hp	do	594.8	2,567.3
100-399 hp	do		
400 hp. and over	do	2,067.8	7,192.8
Aircraft engines:			
Reciprocating	Number	1,064	4,269
Gas turbine	do	(D)	(D)
Aircraft engines, total horsepower:			
Reciprocating	1,000 hp	219.8	926.5
Gas turbine	do	(D)	(D)
Complete aircraft	Number	768	3,237
By weight of plane:			
Under 3,000 lb. airframe weight	do	728	3,085
3,000 lb. airframe weight and over	do	40	152
By number of places:			
1- and 2-place	do	711	2,999
3- and 5-place	do		
Over 5-place	do	57	238
By total rated horsepower, all engines:			
Under 100 hp	do	637	2,744
100-399 hp	do		
400 hp. and over	do	131	493
Value of shipments of complete aircraft and parts, total	$1,000	144,402	473,319
Aircraft, total	do	127,183	426,523
Under 3,000 lb. airframe weight	do	13,780	56,590
3,000 lb. airframe weight and over	do	113,403	369,933
Aircraft parts	do	17,219	46,796
Value of shipments of aircraft engines and parts, total	do	14,813	62,499
Aircraft engines:			
Reciprocating	do	2,483	10,818
Gas turbine	do	(D)	(D)
Engine parts	do	12,330	51,681
Unfilled orders (planes 3,000 lb. airframe weight and over)	Number	543	

D—Withheld to avoid disclosing figures for individual companies.

ometer, manifold pressure, fuel pressure (for the fuel injection system), oil pressure, oil temperature and cylinder head temperature. One fuel quantity gage serves each 26-gal. tank in each wing, with switching provided between tanks. Fuel tank selector also is on the instrument panel, in the lower center area, along with cowl flap control handle and an electric combination primer and auxiliary fuel pump.

The electrical system control panel is roof mounted just above the pilot's head and includes master battery switch, generator switch and circuit breaker, master radio power and light switches.

The large elevator trim wheel, located on the floor between pilot and copilot seats, incorporates a visual position indicator.

Swiss Pilatus Porter Crashes in Himalayas

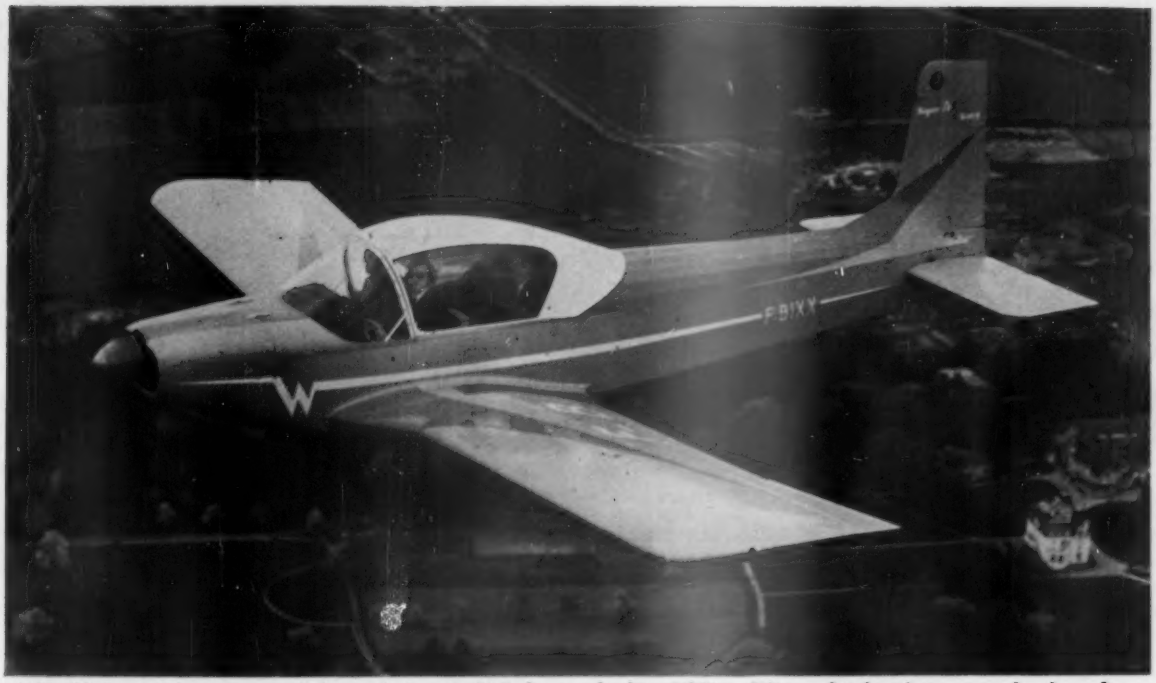
Stans, Switzerland—The Pilatus Porter "Yeti" aircraft employed this spring for supply-dropping to the Swiss 1960 Dhaulagiri Expedition in the Himalayas, crashed on its last mission.

The aircraft had just taken off from the expedition base at an altitude of 17,056 ft. when the control stick's rubber grip came off in the pilot's right hand. The plane was only a few feet from the ground and therefore not sufficient time was left for the pilot to recover. Left wing and propeller of the Porter dug into the sloping snow field and were badly damaged by the impact. Swiss pilot Ernst Saxer and his copilot, Emil Wick, were unhurt but because of the difficult terrain the plane had to be abandoned.

This is the second mishap with the Porter during the approximately six weeks it was carrying out supply-dropping missions in the Himalayas this year, the first time aircraft have been employed by any expedition in the area. In April it developed engine trouble and made an emergency landing in Pokhra about 99 n.i. northwest of Katmanda.

Both pilot and aircraft have been subjected to severe weather conditions and sudden changes in temperature from 105F at the expedition's main base in the valley to around −5F at a height of more than 16,400 ft. during the operations. Although such conditions have had an adverse affect on the performance of the plane as well as on the pilot's reactions, on the whole the Porter stood up well to the rigors of the work demanded.

According to the manufacturers, Pilatus Flugzeugwerke A.G., tests since carried out on the rubber grip of the Porter's control stick have shown that the material stretches considerably when subjected to severe cold.



WASSMER Super IV prototype in flight emphasizes the high degree of cabin visibility. Wing and tail surfaces are made of wood.

Wassmer Begins Deliveries of Super IV

By Robert E. Farrell

Paris—Initial deliveries have begun on a new French four-seat aircraft, the Wassmer Super IV, following the recent award of its airworthiness certificate.

Wassmer, a private company specializing in light aircraft, plans a production rate of two Super IVs monthly. On this basis, company officials say, they have sufficient orders to keep them busy until the end of the year. Meantime, the company currently is pushing a sales campaign throughout western Europe.

Budding Demand

Super IV was designed to meet a budding demand in France and western Europe for a business-tourist aircraft which would be comfortable, reasonably rapid and less expensive than comparable U. S. aircraft.

Super IV, which first flew in June, 1959, has a retractable gear, laminar flow wing and slab tail. French price of the standard version is $15,200. Export price at the factory is $13,600.

Powered by a 180 hp. Lycoming O-360-A1A engine, the Super IV cruises at 165 mph. over a range of just under 1,000 mi. During a recent check flight between Copenhagen and Paris, the Super IV covered the 656 mi. distance in 4.03 hr. at an average speed of 164 mph. from brakes off to the final roll.

Super IV wings are made entirely of wood, the two main sections being rectangular in shape and thus easy to construct. Laminar-flow airfoil is NASA 63.618. Wingtips, into which are fitted navigation lights, are plastic. Main wing spar is fixed at 35% chord. Torsion box extends in front of main spar along the entire leading edge. Each wing contains a 30-gal. fuel tank as well as a recess layout for retracted gear.

Fuselage is of welded steel tube construction and is covered with plywood and cotton fabric. Tail surfaces are of wood with horizontal surface being slab-type.

Tricycle gear and flaps are activated via mechanical systems rather than electric or hydraulic. The gear is raised

THROTTLE control is centered, with propeller pitch control knob above and to the right. Radio controls are in front of copilot's wheel; rudder pedals are suspended.

Shaping the future–

Lockheed's Program Diversification

We are in an era when methods, materials and machines must meet the complex systems characteristic of tomorrow's air/space vehicles. Lockheed's diversification extends from space and atmospheric vehicles to studies of dangers lurking at ocean depths—and how to protect against them.

Such projects start a chain reaction of creativity. They provide new challenges to men of vision. Here are examples of Lockheed's programs that range from research to final development and production:

REENTRY STUDIES pertaining to landing manned space vehicles from orbit or edge of space glide path.

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MACH 3 AIR TRANSPORTS operating from present day airports would cruise at altitudes of 70,000 feet or higher.

ESCAPE CAPSULE developed under U.S.A.F. sponsorship to enable pilots of tomorrow's ultra-high performance aircraft to escape safely. The capsule will allow the pilot to escape at extremely high altitudes and speeds. Control stabilizers, a small rocket engine and survival equipment assure the pilot's safe return.

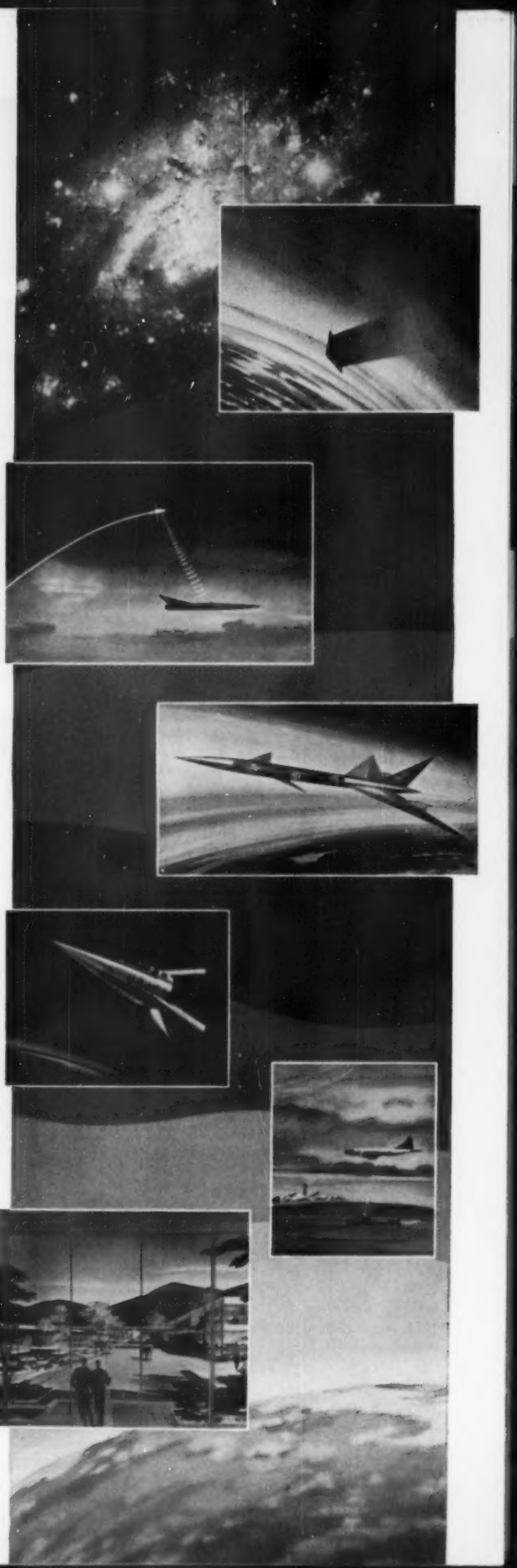
ANTI-SUBMARINE WARFARE systems studies to develop new techniques for neutralizing the submarine menace.

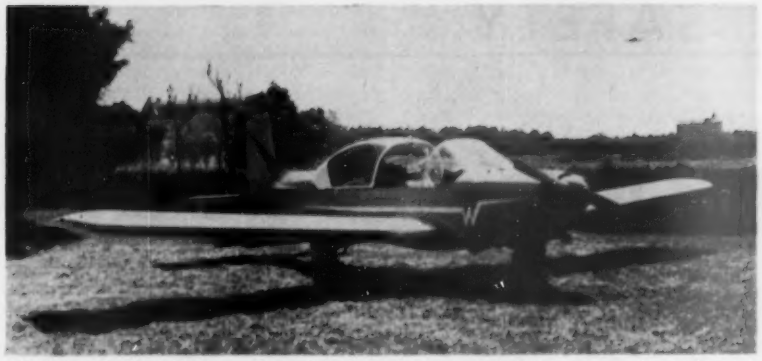
NEW RESEARCH CENTER dedicated solely to advanced research on atmospheric and space flight. Partially finished now, the new multimillion-dollar center will house most of the Division's research facilities.

SCIENTISTS AND ENGINEERS of outstanding ability are invited to investigate opportunities offered by a company that always looks far into the future. Please address your inquiry to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 1107, 2406 No. Hollywood Way, Burbank, California.

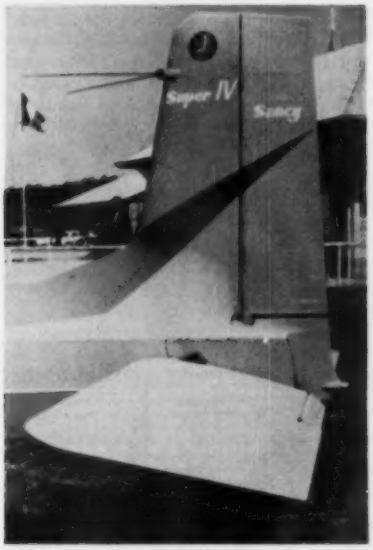
LOCKHEED

CALIFORNIA DIVISION





GROUND VIEW of Wassmer Super IV shows large area of sliding canopy, low silhouette.



SUPER IV slab tail was selected, Wassmer engineers said; for better longitudinal stability as well as decrease in drag.

and lowered with a cabin lever which operates over an angle of 90 deg. A compensating bar under tension handles the load of the gear. Pilot's effort only overcomes the friction in the mechanical linkage.

Ground Handling

Ground handling of the Super IV, as with most tricycle aircraft, is fairly simple.

The nosewheel is steerable. Two main wheels have automobile-type hydraulic brakes applied in unison. Parking brakes are fitted. Suspension is provided by use of thick rubber blocks, another example of company desire to keep maintenance problems to a minimum.

Sliding canopy gives easy access to the rear bench-type seat as well as to pilot and front passenger seats. Noise level during flight is reduced by use of honeycomb material on the center portion of the sliding roof and by double cabin panels. Rear seat is set back at distance which provides more than the usual amount of leg room. Foam-rubber seats are made more comfortable by use of rubber webbing as a suspension system.

A special ledge behind the rear seat provides space for coats and briefcases. The main luggage compartment is located just behind the rear cabin bulkhead and is reached by a side fuselage panel.

Flight instruments provided on the Super IV standard model are an airspeed indicator, altimeter, rate of climb and turn and bank indicators. Standard engine instruments are a tachometer, manifold pressure indicator, oil temperature and pressure gages and cylinder head temperature indicator. Two-bladed fixed propeller is fitted on the standard model although the company offers, as optional equipment, a Mac-Cauley constant speed propeller with a Woodward regulator. All radio equipment is optional.

Wassmer Super IV

Specifications

Weights:	
Empty weight	1,430 lb.
Gross weight	2,640 lb.
Dimensions:	
Span	32.8 ft.
Length	25 ft.
Height	9.4 ft.
Track	10.8 ft.
Wheelbase	5.7 ft.
Cabin width	3.8 ft.
Wing data:	
Wing area	172 sq.ft.
Wing loading	13.9 psf.
Aspect ratio	6.2
Performance	
Maximum speed	170 mph.
Cruising speed (75% power)	165 mph.
Best rate of climb	900 fpm.
Stalling speed	56 mph.
Takeoff distance	1,320 ft.
Landing distance	995 ft.
Service ceiling	19,800 ft.
Range	935 mi.
Fuel capacity	60 gal.

PRIVATE LINES

Howard pressurized 500 twin-engine executive transport is expected to be fully certificated under FAA Part 4b in December or January and under guarantee in purchase contract, airplanes delivered previous to certification can be returned to the factory for inspection and required paperwork involved in bringing them to this standard. Actual performance has shown that the extended wing center section and improvement of rudder boost control system provides a minimum control speed of 93 kt., some 4 kt. lower than previously. Although the cabin is being certificated at a pressure differential of 6.75—providing cabin equivalent of sea level while flying at 16,000 ft. and 2,900 ft. when flying at 21,000 ft.—indications are that structural design will permit that an increase to differential of approximately eight could be certificated if required, according to Howard Aero, Inc., San Antonio, Tex.

Sales gain of 16.6% in business aircraft is reported by Cessna Aircraft Co., Wichita, Kan., for the first eight months of Fiscal 1960 compared with the same period last year. Total number of aircraft delivered in the Oct. 1, 1959-May 31, 1960, period were 2,839 compared with 2,434 in the same period in Fiscal 1959. Low dealer inventories on all models further strengthen the sales picture, according to Cessna Marketing Manager Frank Martin. Model breakdown for this year's first eight months: 262 Model 150s, 816 Model 172s, 465 Model 175s and Skylarks, 180 Model 180s, 489 Model 182s and Skylanes, 450 Model 210s, 177 twin-engine 310s.

Two Republic Alouette II turbine-powered helicopters have been purchased by Air Florida, Inc., for multi-city service in the Tampa Bay area. J. P. Van Pelt, Air Florida president, said plans call for immediate schedule of 56 flights daily.

Piper Comanche 250 has been purchased by Scott Aviation Corp., Lancaster, N. Y., for use in testing advance design concepts of oxygen equipment for business aircraft. The plane also will be used for executive travel.

Grumman Gulfstream turboprop transport has been certificated by Federal Aviation Agency to operate at a cruising altitude of 30,000 ft., an increase over the former 25,000 ft. allowed under CAR Part 4b. Company says new altitude adds another 300 mi. to the Gulfstream's range.

CAB Accident Investigation Report:

Fast Landing Led to Constellation Crash

Capital Airlines Flight 983 of May 12, 1959, a Constellation Model L-049, N 2735A, following a landing at 1529 EST, on a wet runway, was intentionally ground looped and during the maneuver skidded and slid down a steep embankment beyond the boundary of the airport at Charleston, W. Va. One of the 38 passengers and one of the six crew members died in the fire which followed; one passenger was seriously burned and all others on board the aircraft escapted with little or no injury. The aircraft was destroyed.

The aircraft was landed within the first third of the runway and the captain said that finding braking to be ineffective, he chose to ground loop the aircraft rather than risk going down a sharp declivity at the far end of the runway. The aircraft left the runway about 600 ft. from the far end.

Investigation revealed operational deficiencies in the conduct of the approach and touchdown, and that crew coordination throughout the emergency was poor. Because of crew statements, the brakes were believed to have been capable of functioning in a normal manner; however, water on the runway would have permitted the aircraft to aquaplane and thus make them ineffective.

INVESTIGATION

Capital Airlines Flight 983 of May 12, 1959, originated in Washington, D. C., with its destination Atlanta, Ga., and with intermediate stops at Rochester and Buffalo, N. Y.; Pittsburgh, Pa., and Charleston, W. Va. The flight departed Washington at 0957[1] and was routine to Buffalo.

At Buffalo a scheduled crew change was made. The new crew consisted of Capt. R. Ohm, First Officer C. Spoth, Flight Engineer Howanski, Flight Engineer-Trainee B. J. Morrison, and Hostesses N. F. Marshall and E. Viera. Flight 983 departed Buffalo at 1244 and flew direct to the Greater Pittsburgh Airport, arriving there at 1347.

The flight departed Pittsburgh at 1433 and was cleared to Charleston on an IFR (instrument flight rules) flight plan to the Kanawha County Airport at Charleston via Old Concord intersection, to cross the 260-deg. radial of Pittsburgh omni at 3,000 and to maintain 5,000 via 193-deg. radial of Imperial omni. At the time of takeoff the aircraft weighed 81,253 lb., which was 4,284 lb. under the maximum allowable gross takeoff weight at Pittsburgh for an intended landing at Charleston. The maximum allowable gross landing weight for L-049 aircraft for Runway 32 at the Kanawha County Airport is 83,000 lb. There were 44 persons on board which included 38 passengers and a crew of six. Two of the passengers were nonrevenue company employes and one was an infant.

[1]All times herein are Eastern Standard based on the 24-hr. clock.

At approximately 1518 the flight reported to the company at Charleston that it was in range and had 1,800 gal. of fuel on board, and was estimating the Kanawha County Airport at 1525. At that time the special U. S. Weather Bureau report No. 7 was given the flight as follows: clouds 600 ft. scattered, higher clouds 1,500 ft. scattered, estimated overcast 3,000 ft.; visibility 5 mi.; light rain showers; ground fog; wind east-northeast 3 kt.; remarks, ground fog rising from the valleys. At 1522 the Charleston tower cleared the flight to make an ILS (instrument landing system) approach to Runway 23 and upon reaching the outer marker to circle visually to Runway 32; the wind was given as north-northwest 3 kt., and the flight was advised to report when reaching the outer marker and that it was cleared to land. This clearance was acknowledged. In a short time the flight advised the tower that the approach was being abandoned and seconds later the crew advised that it was in the clear and would cross the airport, make a left turn, and would again report on downwind leg. Captain Ohm, who was seated in the left pilot's seat, took control of the aircraft at this time. A normal downwind leg report was made and the flight was again cleared to land on Runway 32. Tower personnel said the flight disappeared from their view momentarily behind scud or ground fog when turning to base leg but, following this, remained at all times in clear sight.

According to eyewitnesses, the approach appeared to be normal and the aircraft touched down 800 to 1,000 ft. from the approach end of Runway 32 and within the first third of the runway distance. The aircraft did not appear to decelerate and just before it approached the intersection of Runways 32 and 23 it veered to the left; a blast of engine power was heard at that time. It continued across Runway 23 and left the paved surface at the far left side of the intersection. The aircraft continued a left ground loop as it crossed the sodded area. At the edge of the embankment it crossed a ridge two feet high, then disappeared from sight over the edge of the steep embankment. When it went over the embankment it appeared to do so right wing first and then the tail section, almost as if it were traveling backward. As the aircraft came to rest it immediately caught fire and was destroyed. One passenger and the flight engineer-trainee were killed. The time of the accident was 1529.

The alarm was quickly sounded and the fire apparatus responded immediately; however, because of the steep downgrade it could not get closer than 200 ft. to the aircraft. Efforts were largely centered on getting occupants away from the burning wreckage and up the hill.

It was later determined that one passenger left the aircraft through the emergency exit over the left wing; the other passengers departed through the passenger entrance door at the rear of the aircraft, and the crew departed th.ough the cockpit windows.

An airport weather observation made one minute after the accident indicated an estimated ceiling of 4,000 ft. with scattered clouds at 600 and 1,500 ft.; visibility 6 mi.; light rain showers; ground fog; temperature 68 deg.; dewpoint 62 deg.; and a wind of 4 kt. from the east-southeast. Rain was falling during the approach and touchdown and had been for some time previously; the runway was thoroughly wet with localized areas of standing water.

The Kanawha County Airport is built on the top of a mountain. Runway 32 is 4,750 ft. long and Runway 23, the ILS runway, is 5,200 long. On May 12, 1959, the latter runway was closed for repairs; it was being lengthened 600 ft. Both runways are paved with a surface consisting of an asphalt and concrete mixture. The terrain at the end of the runways slants downward abruptly.

Civil Air Regulations require that transport category airplanes in scheduled service can be landed within 60% of the effective length of the runway on a dry runway in still air. The effective length of Runway 32 is approximately 3,830 ft., 60% of which is 2,300 ft. According to the FAA Approved Airplane Flight Manual, the stopping distance for a Lockheed L-049 aircraft weighing 78,700 lb. when landed on this runway is 2,300 ft. The remainder of the effective runway length is intended to provide a safety margin.

First Tire Marks

First tire marks were found 3,450 ft. from the approach end of Runway 32. These marks were made by the tires of both the main landing gear and nose gear wheels, and their relation to each other indicated that the aircraft was skidding with the nose gear slightly to the left. Additional tire marks were found 200 ft. farther on. At approximately 3,730 ft. down the runway more tire marks were found. These marks indicated a slightly more pronounced skid and the beginning of a left turn. From this point to where the aircraft went over the embankment, tire marks were continuous. Tire tracks made by the nose gear and the left main gear wheels crossed each other at a point where the aircraft entered Runway 23. The main gear tire marks crossed each other 70 ft. from the edge of the bank. All of the tire marks were merely a whitish discoloration on the runway surface and definitely not the dark marks usually found on a dry runway under similar circumstances.

It was found that the nose of the aircraft

was turning as in a left ground loop; however, the forward movement of the aircraft was a gentle left curve from the paved runway surface to the edge of the embankment. This is best illustrated by the fact that when the aircraft went over the embankment the nose was heading 180 deg.; however, the direction of travel was 290 deg. The distance from where the aircraft left the runway to the boundary of the airport is 286 ft.

Main Wreckage

The main aircraft wreckage was found 200 ft. down the 32-deg. slope. The vertical depth from the surface of the airport to the wreckage is 95 ft. It was determined that the right main landing gear collapsed when the aircraft struck the ridge at the top of the hill.

During the slide down the slope the No. 3 engine was torn from its mounts and completely reversed its position. When this occurred, a portion of a broken propeller blade penetrated the left main fuel tank, and the fuselage broke open on both sides just aft of the forward bulkhead in the forward lounge.

Except for the empennage surfaces, outer wing panels, and the nose gear, the entire structure was destroyed by fire. All powerplants had been subjected to such intense fire that most of the magnesium casings completely burned out. Each engine, with the exception of the No. 3, was found on the ground in its correct position with relation to the wings and fuselage. All propellers had broken blades and all blades were bent forward and counter to rotation. Because of the severe damage to these engines and the fact that the crew said they were functioning in a normal manner when the accident occurred, a teardown examination was not made.

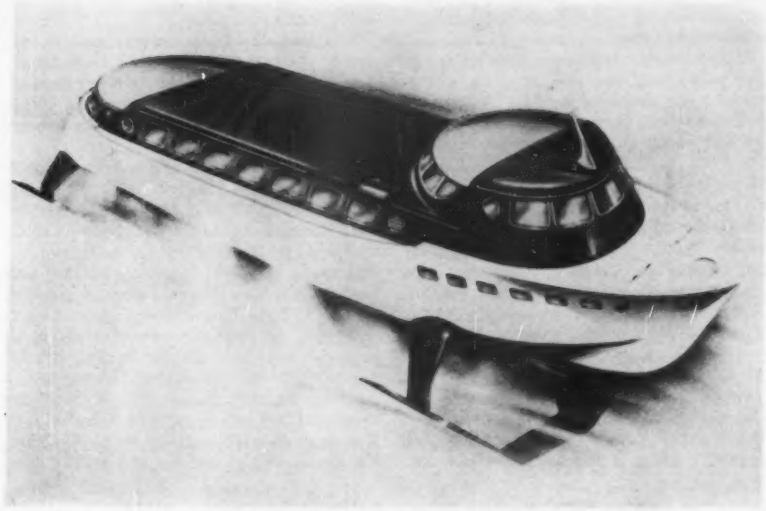
The crew said the approach was made in a normal manner and that the flaps were extended late in the final approach and were fully down at touchdown. Crew also said that during the final portion of the approach an airspeed of 105 kt. was carried.

Witnesses said the flaps were completely down at or just after touchdown. According to the company's flight manual for this type aircraft, the approach speed when crossing the airport boundary (fence speed) is 95 kt.

The crew said further that touchdown was made within the first third of runway distance and that the brakes were applied immediately. Although the brake system appeared to be functioning in a normal manner, with brake pressure normal and hard pedals, the aircraft failed to respond to all efforts to slow it down. The captain said that he ordered the first officer to raise the flaps early in the landing roll to put weight on the wheels and increase traction; the first officer did not hear the command. When it became evident that the airplane could not be stopped within the limits of the runway and that it also

Los Angeles Airport Photographed at 10,000 Ft.

Aerial photo of Los Angeles Airport was taken with a standard Air Force aerial camera at an altitude of 10,000 ft. at a speed of 200 kt. The picture was used in testing a 36-in. focal length lens originally designed for astronomical use. Photographic resolving targets (on grass strip to left of the taxiing C-54) measure 8 x 16 ft. Lens was developed by J. W. Fecker Division of American Optical Co.



Waste King Corp. Proposes Hydrofoil Ferry

Hydrofoil ferry boat proposed by Waste King Corp.'s Technical Products Division would carry 93 passengers at a maximum speed of 44 kt. Interior would be similar to conventional air transports, with lightweight aircraft-type reclining seats.

could not be flown out safely, the captain decided to make a left ground loop and called for full power on No. 4 engine. The flight engineer misunderstood this command and applied power to all four engines. When the aircraft did not respond as the captain wished, he glanced quickly at the control pedestal and, recognizing that all throttles were forward, quickly closed throttles one, two, and three.

The aircraft then began the left turn but too late to remain within the airport boundaries.

Eyewitnesses to the accident stated that the airplane touched down within or about the first third of the runway. An air traffic controller in the tower said that the approach appeared to be normal. Several persons thought the airplane landed faster than this type airplane usually landed. All were in agreement that there was no apparent deceleration of the aircraft in the early stages of the landing roll. One witness said the aircraft was rolling on all three landing gears when 2,000 ft. down the runway.

Three other aircraft were landed at the Kanawha County Airport near the time of this accident and when the weather conditions were similar. One, a scheduled air carrier flight, reported normal braking while the second, also an air carrier, reported poor braking.

The third, a light airplane, experienced difficulty in braking.

Braking Studied

Investigation of this accident was extended to the subject of decreased braking effectiveness because of wet runway surfaces. The National Aeronautics and Space Administration furnished the results of data compiled when tests were made using various runway surfaces and with varying degrees of moisture on these surfaces. These tests indicated that it was possible under certain conditions of speed, weight, moisture, etc., for an aircraft to ride on the film of water (aquaplane) and for the aircraft's brakes to be completely ineffective when this occurs.

ANALYSIS AND CONCLUSIONS

The Board has determined that this aircraft did aquaplane throughout a portion of the landing roll. The white tire marks found on the runway are the color of tire marks definitely associated with aquaplaning. The Board also believes that the approach speed of the aircraft was faster than the recommended approach speed and that this extra speed was partially caused by the lowering of the landing flaps on the final approach. It is further believed that although the aircraft was landed within the first third of the runway, under the conditions which existed, namely a wet runway and without a headwind component, a landing should have been made closer to the approach end, in the interest of safety. Coupling these conditions with the first officer's failure to hear and comply with the captain's order to raise flaps in order to put weight on the wheels, it is easy to understand why an early deceleration was impossible.

The above facts, however, are not the complete story. At some point in the landing roll the captain realized that something must be done immediately or the speed of the aircraft would take it over the embankment at the end of the runway. At that time he was faced with a real emergency and it does not seem in keeping with the gravity of the situation that he would delegate the handling of the power controls to the flight engineer. Recognizing that the power to delegate is discretionary with the captain, the Board nevertheless believes that in this instance this was not optimum procedure and that instead the handling of the throttles by the captain may well have resulted in less disastrous results. It is interesting to note that since the accident the company has placed the prohibition on the landing of all Constellation aircraft on Runway 32 unless the runway is dry and there is a headwind component.

The Board determines that the probable cause of this accident was the pilot's action of landing the aircraft too fast on the wet runway under conditions conducive to aquaplaning, making early deceleration impossible. An additional factor was the poor coordination of the crew throughout the approach and landing.

By the Civil Aeronautics Board:

WHITNEY GILLILLAND (Chairman)
CHAN GURNEY (Vice Chairman)
G. JOSEPH MINETTI (Member)
ALAN S. BOYD (Member)

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident on May 12, 1959, shortly after occurrence. An investigation was immediately initiated in accordance with the provisions of Title VII of the Civil Aviation Act of 1958. The Board ordered a public hearing which was held at Charleston, W. Va., June 24-25, 1959.

Capital Airlines, Inc., is a Delaware corporation with principal offices in Washington, D. C. The company holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation by air of persons, property, and mail. It also holds an air carrier operating certificate issued by the Federal Aviation Agency.

Capt. Richard Vincent Ohm, age 32, was employed by Capital Airlines on Feb. 15, 1957. He was properly certificated and rated for the subject flight. Captain Ohm had a total piloting time of 4,966 hr. of which 408 had been as copilot on Constellations and 293 as captain on Constellations. His last physical examination was satisfactory and his rest period during the 24 hr. preceding this flight had been 17 hr. and 35 min. During the 30 days preceding this accident he made six landings at the Kanawha County Airport.

First Officer Charles Victor Spoth, age 27, was employed by Capital Airlines in Feb. 1957. He was properly certificated and rated for the subject flight, and had 822 hr. as Constellation copilot. His total piloting time was 2,321 hr. He also had been into Kanawha County Airport four times within the previous 30 days, and had 21 hr. of rest during the 24 hr. preceding this flight.

Flight Engineer John Howanski, age 39, was employed by Capital in June 1950. His total time as a flight engineer on Constellations was 6,830 hr. and he was properly certificated and rated. Mr. Howanski had had 17 hr. of rest during the 24 hr. preceding this flight.

Hostesses Evelyn Viera and Nancy Marshall had satisfactorily completed the company's training courses, including those for emergency procedures.

The aircraft was a Lockheed Constellation, model 49E-46, N 2735A, serial number 1978. It had been purchased by Capital Airlines in Oct. 1954. At the time of the accident it had been operated a total of 29,589 hr. All overhauls and inspections were current and maintenance had been kept current. Engines were Wright Cyclone, model 3350BA-3, and propellers were Hamilton Standard, model 33E60. All powerplant maintenance was satisfactory.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Capt. John Jay Ide, USNR, has been awarded the cross of Chevalier of the Legion of Honor by the French government. For the last year Capt. Ide has been president of the Federation of French Alliances in the U. S. and is currently vice president of the Federation Aeronautique Internationale.

William J. Tull, vice president of GPL Division of General Precision, Inc., has been awarded the Thurlow Navigation Award, the highest honor conferred for advancing the science of navigation, by the Institute of Navigation for his work as the pioneer of doppler navigation. Also, the Institute of Navigation's first annual Samuel M. Burka Award was presented jointly to **Norman V. Petersen, Leroy R. Hoover** and **Dr. Leonard Pode,** the authors of a Northrop Corp. satellite rendezvous study.

Dr. M. B. Hogan, manager-reliability engineering in General Electric's Heavy Military Electronics Department, has been elected to the rank of Fellow in the American Society of Mechanical Engineers.

Dr. Ira Dyer, a physicist with Bolt Beranek and Newman, Inc., has been awarded the Acoustical Society of America's Biennial Award for his "contributions to jet engine noise analysis and noise-induced vibration as related to the performance of missiles and space vehicles."

Changes

Robert Powelson, assistant director-Mauler administration, Mauler weapons system department, Convair/Pomona, Convair Division of General Dynamics Corp., Pomona, Calif., and **F. Edward Huggin,** chief of Mauler system engineering.

Dr. Ernst H. Krause, head of Electronic Systems Operations, Aeronutronic, a division of Ford Motor Co., Newport Beach, Calif., and **Dr. S. Dean Wanlass,** general operations manager of Computer Products Operations.

Frank E. Mamrol, chief engineer, Piasecki Aircraft Corp., Philadelphia, Pa.

Harry N. Beffort, plant manager, Avro Aircraft, Ltd., Toronto, Canada, and **W. G. Eves,** assistant plant manager.

H. French Harris, manager-Discoverer and Samos satellite projects, Western Development Labs., Philco Corp., Palo Alto.

Peter S. Given, manager-airborne products, SKF Industries, Inc., Philadelphia, Pa.

George Friedl, Jr., director of operations, Houston Fearless Division of Houston Fearless Corp., Los Angeles, Calif.

Guy J. Sanders, chief engineer, Sound Control Department, Metal Products Division, Koppers Company, Inc., Baltimore.

Col. John E. Watters (USA, ret.), engineering manager, Motorola's Western Military Electronics Center, Scottsdale, Ariz.

Duncan B. Gardiner, manager-corporate engineering, Vickers, Inc., Division of Sperry Rand Corp., Detroit, Mich.

Joseph C. Hyatt, manager-customer relations, U. S. Science Corp., Los Angeles, Calif., a division of United Industrial Corp.

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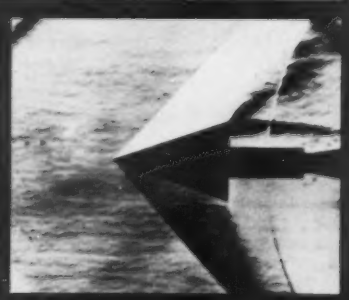

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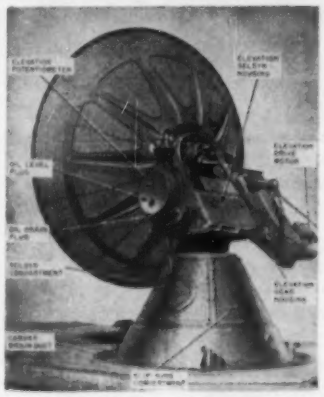

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LETTERS

Recon Photographs

In regard to the special report entitled "Ground, Air Planning Accelerate RF-101C Scramble Rate" (AW June 13, p. 54), it was very encouraging to read of the operational proficiency of our USAFE.

In consideration of the very excellent photograph of the hydroelectric installation taken by Capt. Yeager in the RF-101, an interesting question is raised from the tactical point of view. Let us quickly review the flight parameters involved in Capt. Yeager's photograph: altitude—500 ft.; velocity—290 kt.; camera focal length—6 in.; installation—left oblique at 30 deg. depression angle. The question then concerns the combination of the first two parameters listed above: what kind of survival rate can we expect from a 101 literally traveling on the deck when only flying at the throttled down speed of 290 kt.? Also, why should this excellent aircraft be limited to a velocity less than one half of its capability at this altitude? (Capt. Jeager had to throttle back to slower than usual speeds!)

In answer to the above question, it would appear that the aircraft's performance is markedly limited by its reconnaissance equipment.

There are a number of cameras, such as the KA-30, available today that are capable of taking the same picture as Capt. Yeager's at velocities of over one thousand knots! (If the aircraft could fly that fast at 500 ft.)

Certainly then, from the tactical viewpoint, photographs taken at Mach 1 speeds or greater while on the deck would be much more realistic for training and absolutely necessary should the big button be pushed.

James R. Dunn
Manager, Service Engineering
Chicago Aerial Industries, Inc.
Melrose Park, Ill.

Cuban Flights

I subscribe to Aviation Week and have been reading your magazine for over eight years. In my opinion, it is the best informed source in the field of aeronautics in this country.

On the article under the title "FAA Warns Airlines on Flights Near Cuba" (AW June 13, p. 40) you reported a news item which at the time had enough interest behind it to justify printing it. However, the explanations and accounts behind the story as given by a Mr. Eduardo J. Whitehouse should not be included in your reputable magazine.

These days we see on newspapers, magazines, television programs and other means of communications how these headline hunters come up with these incredible "stories."

Magazines and newspapers that thrive on sensationalism grab these accounts and promote the men that conceived them to the level of decent citizens. Their past in Cuba which incidentally does not go more than two years back, does not seem to matter any more. I assume that you have read that Mr. Whitehouse's testimony was later disregarded completely by the agency that was investigating it. It seems that his testimony had so many discrepancies that it was just impossible to take it seriously. At the risk of being repetitious, let me say again that Aviation Week is an excellent scientific magazine and you should not lower yourself to printing reports of these unscrupulous politicians. Keep your standards high!

Robert Valdes
Cocoa Beach, Fla.

(Aviation Week ran this story to report the actual fact that the Federal Aviation Agency had advised U. S. carriers against instrument flying in the area of Cuba as a result of testimony given a Senate subcommittee by Eduardo Whitehouse. Only those statements in Whitehouse's volunteered testimony which prompted the FAA action were used in the article; other items were omitted after thorough checking by Aviation Week. —Ed.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Jet Parts Prices

How well your article "TWA Scores Jet Airliner Parts Pricing" (AW June 13, p. 47) proves that the saying "You get what you pay for" sometimes is not quite true!

However, I can't help wondering if possibly the airlines' purchasing departments are remiss in permitting such a situation to exist, especially at times of a buyers' market.

Peter C. Bachner
Westwood, N. J.

Your article "TWA Scores Jet Airliner Parts Pricing" in the June 13 issue (p. 47), points up a problem which also plagues the military services, namely, the high cost of spare parts.

Some items are extremely costly by nature of their complexity and the engineering involved. Other exceedingly simple items are also priced at unbelieveable levels, and one hears vague mutterings about reliability and safety by way of justification.

I am certain that TWA sees no way in which a $122 toilet seat will make their airliner safer or more reliable, but that same sum spent on some other component might have been just what was needed to produce a safer airplane.

One finds a modern airplane jammed full of items which have not been made more reliable by an artifically high price tag. This can lead to the conclusion that an ordinary power lawn mower (which is really quite a complex item) produced by an aircraft company would probably sell for over a thousand dollars, yet would not necessarily be more reliable.

Airplanes occasionally feature extremely reliable equipment, though; the GE turbosupercharger regulator on the AJ-2 Savage was such an item. Obsolete now, but orchids to the engineers who designed that ray of sunshine for an otherwise stormy climate.

Electronic equipment cost and reliability (p. 87, same issue) is another problem. History is against the "AGREE" (electronic reliability) people, since even nature's own "two tube transmitter" after millions of years of development is still costly and not particularly reliable. I wish them the best of luck.

Realistic design and pricing of aeronautical and space items will do much to improve the military posture of this country. A $122 toilet seat is not a particularly effective deterrent weapon.

Robert H. Belter
LCDR, USN
Monterey, Calif.

Manpower Waste

Saving our country—without the B-70?

Having previously laid himself open to being compared with an ostrich with his head in the sand by stating that there was no race for space—after the United States had lost same—the apparently confused, "Concerned Citizen" from Long Island (AW June 20, p. 366) now "kills" the inevitable production program for the B-70 Mach 3 aircraft by a statement of his, mixed among numerous platitudes.

His letter indicating the relatively non-wastefulness of the Navy is inept. My experience—from coast to coast twice—in aircraft engineering since 1940 emphasizes that the three services are equally wasteful—expecially of engineering manpower.

Carl Heyl, Engineer
Stamford, Conn.

SAC Alerts

Re: Letter "SAC's Duty," issue of May 30 (p. 104).

If SAC aircraft commander Lambert of Orlando does not like spending one-third of his young life on alert then perhaps he would like to join me in leaving SAC? As a combat-ready B-47 copilot I find myself ensnared in the jaws of an organization which has such a great percentage of its aircraft on alert that it not only cannot provide enough flying time to maintain proficiency, but it further assigns me to alert one week in every three. A few hours per month spent reading checklists from the back seat of a B-47 does not, in my humble Century series-bred opinion, constitute satisfactory flying anyway. Since the Air Force had no qualms about mal-assigning me into the back seat of a multi-engine plane from F-100s, then I shall have no qualms whatever about leaving the Air Force as soon as I possibly can. Does anyone anywhere in the world desire the services of a brash fighter jock turned checklist reader?

1/Lt. Dennis K. McDaniel
368th Bomb Squadron
MacDill AFB, Fla.

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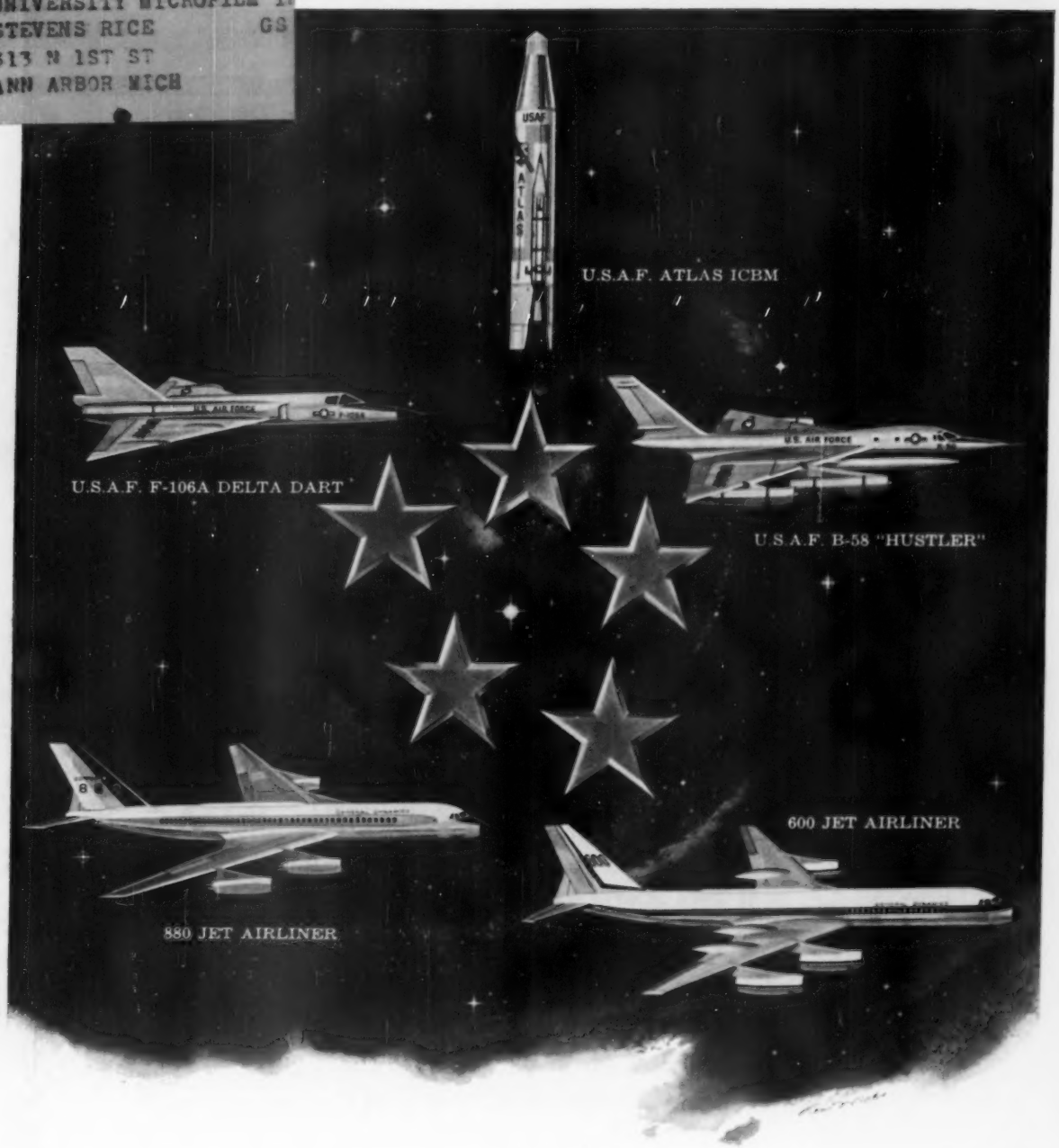

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